AN ELECTROMYOGRAPHIC STUDY OF PREPARATORY SET IN SINGING

AS INFLUENCED BY THE ALEXANDER TECHNIQUE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
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By

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* * * * *

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ACKNOWLEDGMENTS

It is reasonable to predict that most of the future readers of this page will be individuals who are either engaged in current doctoral research or have already survived the experience. This is appropriate, for such readers will surely be best able to appreciate the depth of gratitude expressed here.

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FIELDS OF STUDY

Major Field: Vocal pedagogy

Studies in vocal performance, music education, conducting, and composition
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CHAPTER I
INTRODUCTION

Need for the Study

Some voice teachers and choral directors look with suspicion on experimental research in singing. They contend that teaching singing requires only a good ear and sufficient experience. It is certainly true that physiological knowledge will not in itself improve a teacher's ability to develop voices. In fact, a little knowledge is often more dangerous than no knowledge at all, especially when it enables poor teaching to hide behind mis-applied scientific jargon and procedures. Though it is not necessary to defend the value of basic research in any area of human performance, it must be admitted that the "vocal music educator on the street" lacks both the time and expertise required to keep pace with the growing body of experimental research regarding the singing voice. The profession will always need to rely on experts who can sift through exotic technical information and distill it into useful forms. A well-known example would be Richard Miller's The Structure of Singing: System and Art in Vocal Technique (1986).

The subject of this study, however, is intricately related to almost every problem faced in the voice studio. Teaching singing is largely concerned with overcoming problems caused by physical and
psychological habits, and these habits begin to operate during the
student's preparation to sing. As will be seen (see pp. 16 ff.),
the vocal pedagogy literature clearly shows that teachers recognize
the importance of influencing what singers do in preparation for the
vocal attack. This recognition is not only reflected in directives
about posture or inhalation. Much of the psychological imagery used
in the voice studio has the goal of improving phonation by changing
the singer's anticipatory mental state.

It is therefore particularly interesting that experimental
research in voice has largely overlooked the subject of preparatory
activity or set. Instead, researchers have examined what occurs
after phonation has begun, through acoustical analysis of the tone
itself, examination of the musculature of the singer, or a
combination of both. There has been no systematic study of how
vocal tone quality is related to preparatory psychomotor sets.
There is a need for such research in the field of vocal pedagogy.
This study was therefore conceived as an early exploracion into an
unexamined area of vocal production. It was anticipated the
experiment would provide preliminary information which would
stimulate and aid further work in the area.

A secondary focus of the study was the Alexander Technique.
Many conservatories and schools of music include Alexander
instruction as part of their curricula, and singers and
instrumentalists are enthusiastic about the effect of the Alexander
Technique on musical performance. But, though it is widely credited
with producing remarkable results, relatively little experimental
research has been carried out on the Technique, especially in connection with singing. There was a need for further research on how Alexander training influences vocal performance.

**Purpose of the Study**

All voluntary movement is preceded by a preparatory phase, or "set," in which muscle balance and posture are adjusted and the organism adopts a state of readiness appropriate to the ensuing movement. Inefficient adjustments during this preparatory set result in poorly coordinated movement. Instruction in motor skill development seeks to influence the quality of such anticipatory activity, usually by indirect means.

The purpose of this research was to determine the impact of preparatory set in singing. Surface electromyography (EMG) was used to measure the preparatory activity of three muscles of the neck (implications of this restriction are discussed on pp. 5 and 84). One group of subjects received 10 days of training in the Alexander Technique and a second test group was given instruction based on Jacobson's Progressive Relaxation Therapy (for a description see p. 69 and Appendix D). A control group received treatment consisting of standard vocal exercises. Audio tapes and EMG data were collected both before and after treatment and analysed using appropriate means. A complete description of the research design is found in Chapter III.
Hypotheses and Sub-Hypotheses. The research questions are presented below and will be restated in Chapter IV.

Hypothesis #1:
Though all three treatment groups will show some improvement in singing quality following treatment (due to maturation), the groups receiving special training in kinesthetic awareness and/or relaxation (Alexander and Body Awareness) will improve more than the group that merely vocalized. The Alexander group will make the most improvement.

Hypothesis #2:
There will be correlations between improvement in singing quality and observable changes in preparatory muscle behavior as measured by EMG (The specific EMG measures will be described in Chapter IV).

Hypothesis #3:
When subjects are required to attack the tone on a certain beat, the preparatory response will be more consistent than when they are allowed to attack the tone whenever they want to. The standard deviation of trials on Part II (using the same EMG measures as in Hypothesis #2) will be lower than those on Part I.

In addition to the three primary hypotheses, a number of sub-hypotheses were identified:

Sub-Hypothesis #1:
Preparatory set for singing is a recognizable, non-random pattern of behavior characteristic of each individual.

Sub-Hypothesis #2:
Preparatory set behavior is stable across different singing conditions (e.g., across variations in pitch and intensity).

Sub-Hypothesis #3:
Patterns of preparatory set behavior can be identified which are common to a number of people.

Limitations

It must be clearly understood that no single study could ever hope to comprehensively examine preparatory set. When a singer gets ready to sing, a vast number of psychological and motor activities
occur which could never all be measured simultaneously. This study recorded EMG activity in three selected muscles of the neck. No general conclusions may be derived from such limited data. Nor may changes in EMG activity be carelessly equated with "improvement" in preparatory set: A reduction in the tension of one muscle may simply signify a redistribution of the tension into some other part of the muscular system.

The use of surface EMG was a limitation of necessity in this study. Muscles of the larynx itself as well as the most important laryngeal support muscles were eliminated from consideration (see page 84 for detailed rationale). Surface electrodes are less selective than needle or fine-wire electrodes, and surface EMG is subject to more sources of experimental error. The EMG data from this study must therefore be interpreted cautiously and regarded only as a starting point for future study.

The study was limited to a rather short treatment period lasting 10 consecutive weekdays. Though habitual response patterns are resistant to change, it was hoped that even this short treatment time would influence preparatory muscle behavior enough to be measured.

This study was limited to 24 subjects, a size determined by the available subject pool, financial limitations, and time restrictions. Though only 12 of these subjects were involved in EMG testing, this number is actually quite sizeable for an EMG study.

This investigation used beginning singers: students with no previous vocal training and limited choral singing experience. This
was done to make use of the available subject population (a non-major voice class at OSU!) and to provide some control over the effects of prior training. The study thus did not investigate the relationship between preparatory set behavior and amount of voice training. Subjects were all undergraduate non-music students between the ages of 18 and 23.

This study examined the Alexander Technique only in connection with its influence on preparatory set. The reader is cautioned against forming incomplete concepts of the Alexander Technique because of the limited scope of this project (See The Alexander Technique, p. 23).

Background and Definitions

This section will present background and definitions necessary to the understanding of this project. The first part will define preparatory set by examining the distinction between, and interdependence of, reflexes and habits in voluntary movement, and by showing the critical role played by the preparatory set in determining the efficiency of movement. Four commonly used approaches to influencing preparatory set in voice training will then be explained. The second part will provide an introduction to the Alexander Technique by describing Alexander's discoveries and comparing the principles of the Technique with the approaches to vocal pedagogy described earlier in the section.

Definition of Preparatory Set. Gibson (1941), in a critical review of the concept of set, writes that the idea of set "is a
nearly universal one in psychological thinking, despite the fact
that the underlying meaning is indefinite, the terminology chaotic,
and the usage by psychologists highly individualistic" (p. 781).
English and English (1958) list a few of the common synonyms of set:
tendency or disposition; orientation, guidance or determination;
preparation, expectation or readiness; facilitation; fixity or
rigidity.

Gibson (1941) points out that the definitional waters got muddy
when, around the turn of this century, psychological researchers
began to observe that "the events during a psychological
experiment--reaction, association, judgments, or thoughts--were
determined by something other than the reportable events themselves
and that this itself was a psychological problem" (p. 783). This is
to say that each human subject brings to an experiment a unique
collection of expectations and task-attitudes. These unseen factors
must be regarded as important elements of the overall experimental
condition.

Early psychological theorists regarded set as a "temporary
facilitating condition produced by instruction or by some
manipulation of the experimental conditions" (English and English,
p. 495). Later and contemporary uses of the term include the
recognition that "a temporary set can become an enduring disposition
or habit, a simple attitude" (English and English, p. 495). Evarts
(1984), in a detailed summary of the use of the term "set" in
psychology, defines the word as "a state of readiness to receive a
stimulus that has not yet arrived or a state of readiness to make a movement" (p. 8).

A controversy in this area of study has been whether there can be a clear distinction between perceptual and motor set. Cognitive-oriented theorists regard the pre-existing psychological state and level of arousal as important aspects of the preparatory set. Behavioral theorists would tend to reject such a viewpoint, or at least contend that covert aspects of set are irrelevant since they cannot be measured. Behavioral research generally attempts to quantify preparatory set in terms of overt motor response.

The reality seems to be that there is no sharp dividing line between the mental and physical components of set. Voluntary movement is a continuum which stretches from the very first dawns of intent (the will to move or act) through the actual movement itself.

Preparatory set is thus an extremely complex phenomenon which includes the psychological aspects of expectancy and perceptual orientation as well as the motor aspects of muscle and posture readying. Though researchers may attempt to prove that one factor is causative for the other, "psycho" and "motor" are functionally inseparable.

As soon as an action is conceptualized, the body adopts a state of readiness based on previous experience with that task or similar tasks. Posture is adjusted so the center of gravity is correct and the appropriate muscle groups are in proper mechanical relationship. Muscle tension levels rise and muscle activity is balanced. Heart
rate and other autonomic body functions make spontaneous preparations. Finally, and very significantly, feedback mechanisms are activated which will be used to monitor the ensuing movement (See Chapter II for citations regarding physiological responses during preparatory set).

These preparatory behaviors can be viewed as elements of a motor program selection process. Theoretical models of movement control generally propose the existence of some sort of motor memory pool in which the brain stores the countless details of each previously performed movement. The conscious decision to carry out a movement acts only as an executive, passing the command on to lower levels of the brain which are responsible for implementing the movement itself. These lower levels take care of coordinating all the preparatory activity necessary to carry out the action. The motor program includes a kinesthetic memory which is used to compare the latest effort with previous ones. Most corrections are made beneath the level of conscious thought. Only major coordinative problems (which exceed a certain threshold) are referred to the executive level (the conscious mind) for help. The physiological changes that occur in the preparatory set are thus merely the first output of a comprehensive programmed response pattern selected by a sub-cortical part of the brain.

**Conditioned Reflexes and Habits.** The term reflex is used in two ways. The first describes an autonomic, unlearned reaction to a stimulus which is mediated by the spinal cord and lower brain stem. The most commonly known reflexes are those involved in emergency
protective actions, such as drawing one's hand away from a hot surface. Most autonomic reflexes, however, operate continuously, maintaining balanced function within the entire body. Autonomic reflexes allow us to maintain upright posture, for example. (Some aspects of this postural reflex system will be described in Chapter II in order to facilitate understanding of the Alexander Technique.)

The other use of the term reflex is in connection with learned or conditioned responses. These responses also occur without conscious thought, but they are not the result of neurological reflex arcs. They are automatic but not autonomic and are referred to as reflexes even though they are not innate. The conditioning may be the result of general experience, hereditary inclination, imitation, or structured teaching. In any event, the conditioned reflex behaves just as though it were a true innate reflex. Both kinds of reflexes "click on" automatically in response to stimuli. McCormack (1958) writes, "operationally, then, it is unnecessary to distinguish among instincts, or to distinguish them from unconscious habits as factors which regulate responses" (p. 70). This concept is also discussed in Sweigard (1974, p. 165).

When it comes to motor learning, the automaticity of these learned reflexes is simultaneously a great blessing and a great curse. Without conditioned reflexes movement itself would be impossible. We cannot exercise direct control over the specific muscle tensions and balances required for even the simplest movement. As mentioned above, the conscious brain delegates this responsibility to lower coordinative structures which take care of
switching on the correct reflexive movement patterns. This enables us to do very useful things such as drive a car while thinking about something else.

On the negative side, conditioned reflexes are extremely difficult to change because they lie below the level of consciousness. We have only to imagine a movement or decide to do it and the body responds with a reflexive response before we are even aware of what we are doing. When we want to improve our performance of any movement, we must extinguish inefficient reflex responses and replace them with correct ones. This process is the battleground of all pedagogy in psychomotor skills. Teaching is a strategic intervention designed to change reflexive conditioned responses.

Within each individual, a vast number of conditioned reflexes combine to form movement habits. These habits operate below the level of consciousness and influence how we perform familiar activities. Referring to the acquiring of poor speech habits, Boone (1977) writes, "the vocal trauma of a particular event may produce temporary laryngeal changes that cause compensatory vocal behaviors that persist and become the individual's particular set for subsequent vocal behavior" (p. 9). If some kind of vocal misuse is reinforced it will become "a permanent part of the patient's vocal repertoire" (p. 9). Such improper voice production "quickly becomes automatic and involuntary, and as such is resistant to voluntary modification" (p. 10).
Though extremely incorrect movement or posture habits draw attention to themselves because they cause inefficiency or pain, a great many poor habits are adopted without being noticed. We eventually come to accept them as correct simply because it is the way we move. It is common to see someone sitting or standing in a posture that exerts tremendous pressure on the spine, but the person is unaware of anything unusual. Whatever we habitually do with our bodies eventually feels right to us. In fact, as discussed below, we can even reject more efficient coordinations or postural alignments because they feel awkward and unfamiliar.

Furthermore, when we want to learn some new motor skill, we have no choice but to interpret directions (from teachers or ourselves) from within our habitual frame of reference, our kinesthetic sense of what is "right." If this frame of reference is distorted, the new movement will inherit the weaknesses and inefficiencies of the underlying habit pattern.

The Reassurance of the Familiar. We determine how well we are doing a particular movement by the way it feels kinesthetically. In his book, Inner Tennis: Playing the Game, Gallwey (1976) tells the story of helping a young lawyer improve his tennis serve. The lawyer's serve was weak and inaccurate despite prodigious straining, grunting and intensity. Gallwey encouraged him to "stop trying" and "let the body serve the ball," and was amazed as he saw the weak serve quickly transformed into a powerful, accurate one. The lawyer was putting out only a fraction of the effort but getting many times the result. Gallwey noted, however, that his student seemed puzzled
rather than pleased. A week later, at the next lesson, the lawyer had reverted back to his old, ineffectual serve. He confessed,

Oh that, well to tell you the truth I have to admit that I really didn't like that serve much. I know that it was quite a bit faster and was accurate, but I didn't seem to have any control over it. I didn't feel I knew what I was doing [italics added]. This serve may not be as strong or as accurate, but at least I know what I'm doing. (p. 19)

If Gallwey had merely suggested a different grip or a new arm trajectory, the lawyer could have worked from within his existing habitual framework. When, however, the instructions resulted in a completely new kind of kinesthetic feel, he became uncomfortable. Grunting and straining on his serve was his way of knowing what he was doing. He rejected the new coordination even though he could see objectively that it was better. Similarly, Reid (1965) says that the student of singing suffers from

the fear of bodily expansion, fear of the unknown, of making bad sounds, of "letting go," of having no control because of having relinquished habitual controls...The familiar is always more reassuring than the new. (pp. 191, 192)

A person's pattern of muscular effort is often consistent from activity to activity. The tennis player described above would likely overwork his body just as much when chopping wood as when serving a tennis ball. At his voice lesson, his singing would tend to be forced and tight. He might lose patience with the teacher's efforts to encourage a lighter, easier phonation, preferring lots of push and throat tension simply because it gave him more familiar kinesthetic feedback. His preparatory set for singing might include stiffening the abdominal muscles, bracing the spine, neck, and head, and tightening the lower jaw.
The scene just described is intended to reinforce the fact that the learned reflexes that comprise preparatory set for singing are always derived from and consistent with larger habit patterns which influence all movements (including serving a tennis ball). Thus, though poor phonation may be said to be "caused" by inefficient preparatory behavior, the preparatory behavior itself is not the real source of the problem. Teachers of any kind of motor skill must deal with the powerful influence of underlying habit patterns which often cause students to resist change without even being aware of what they are doing.

**Preparatory Set as the Point of Control.** In conducting, the preparatory beat is extremely important. The conductor must accept the disconcerting thought that he or she has no control over the ensemble at the actual moment of attack. An instant after the phrase begins the conductor may make further adjustments, but he or she can never go backwards and change a previous beat. In a similar way, the quality of a movement is influenced by what goes on during the anticipatory phase. By the time a movement actually begins, control of the musculature has passed from the conscious mind to the sub-cortical brain, which can only operate reflexively.

Thus, it may be argued that the battleground in improving any motor skill is the preparatory phase. If anticipatory activity is not changed, the movement will automatically be carried out in the old, habitual manner. Excess tension, imbalanced muscle use, or poor posture which are part of one's ingrained pattern of body use
will "click on" in response to the decision to act. The war will be over before the battle even starts.

It is certainly true that adjustments can and must be made after movement begins. It seems that this is the process that is used to control movements which are slow or sustained. Many movements, however, occur as a unified whole (such as the pitching or hitting of a baseball) and happen faster than the response time of any internal feedback loop. Such movements rely almost totally on proper preparatory activity since they cannot be corrected once they begin (B. Jones, 1974).

Singers obviously make continual adjustments during the singing of any phrase, but teachers and singers recognize that the quality of the attack largely determines the success or failure of the phrase (see quotations in the next section). Relying on feedback correction after a movement has begun is a very inefficient way to learn a skill. It is a little like forcing an airliner to make constant in-flight course corrections because the pilot neglected to file a proper flight plan.

Finally, changes in a movement (or singing coordination) which are consciously superimposed after the movement has begun tend to disappear as soon as the concentration stops. This is particularly true if the changes contradict underlying habit patterns. Bad singing habits will usually win out in the end if we wait to initiate changes until after the tone has begun.
Preparatory Set in Vocal Pedagogy. Teachers of singing recognize the importance of preparatory set in singing. Early singing texts stressed slow, steady inhalation and mental readiness as keys to good singing. Manual Garcia (1894) said that "all control over the tone is lost once the vocal tone becomes vibratile" (p. 12). Francesco Lamperti (1980) made the startling suggestion that the student inhale over a period of 18 seconds! He believed this would insure that the tone was "full and stable, whereas inhalation of six, nine, or twelve seconds would result in the sound lacking in steadiness and feeling." Francesco's son Giovanni believed that "to know the result before we act is the 'golden rule' of singing" (Brown 1931, p. 15). Shakespeare (1921) made the fascinating statement that "the first badly produced note in any phrase carries the control of the breath out of our power" (p. 35). Wilcox (1945) echoed early Italian teachers when he stated that

all of the conscious control of the breathing act must be centered on inhalation. The whole 'set' and 'tone' of the voice-producing organism will be determined by the manner and degree of the breath intake. Once a tone is begun, any effort at conscious control will merely interfere with the natural coordination of the muscles involved. (p. 8)

Koppel (1956) was sure that "most forcing and straining stems from anticipatory tension, before we even start singing" (p. 15). Kagen (1960) insisted that a clear mental concept of the tone determines the quality of the production. This mental image, he said, "compels our sound-producing mechanism to adapt itself in a most minute and delicate manner" (p. 39). Reid (1975) succinctly stated that "all devices and techniques designed to improve the tone after the coordinative pattern has been set are useless" (p. 31).
Teachers of singing thus direct much of their effort toward influencing preparatory activity, even though they usually would not define their objectives in such terms. Almost all pedagogical imagery is somehow designed to bring the factors of breathing, phonation, resonance and interpretation into a proper balance at the moment of attack. The next section will discuss various approaches used to achieve this end in the light of what has been said about the reflexive nature of habitual preparatory sets.

**Vocal Pedagogy Techniques and Preparatory Set**

**Relaxation.** Every physical activity requires balanced muscular effort. Yet voice teachers and choral directors are constantly encouraging singers to relax. What is relaxation intended to accomplish?

Teachers of singing agree that indiscriminate muscle flaccidity will not solve vocal problems. Appleman (1981) stated that "singing demands the erection of a [muscular scaffolding] of balanced tension in the supra- and infra-hyoid group that must always be sustained through every change of pitch and intensity" (p. 5). Rose (1962) referred to the need for discovering and maintaining an ideal [ratio] of muscle effort during singing. Finally, C. Lamperti’s paradoxical statement makes sense to all who work with singers: "Do not become rigid! But never relax" (Brown, p. 116).

Still, relaxation techniques are very helpful in the voice studio. Why? It is because they are an indirect means of influencing the singer's preparatory response. Reid (1975) said
that relaxation is valuable only in that "it helps the student assume a proper attitude of readiness. Relaxation is merely a preliminary condition of being, one which is essential to free response, not a part of the response itself" (p. 8).

Asking for general relaxation before a task works on the same principle as making a class of noisy children all put their heads down on their desks with eyes closed. Once calm is restored, the teacher may then allow individuals to express themselves in an orderly manner. The actions that are really necessary to the activity can occur without interference from other forces. The voice teacher wants to exercise similar control, not over the parts of the voice that should be involved, but over those renegade muscle tensions that have habitually been getting in the way. Relaxation is thus a process of "non-doing" which helps the singer get out of his own way.

While relaxation may produce temporary improvements in function, real learning benefits will only accrue when the student can connect the improved performance and the relaxation in terms of his own inner kinesthetic awareness. A singer may notice that a tone is easier to sing but may not really know why except that relaxation is experienced. Subsequently, the singer superstitiously applies relaxation as a magic formula without being guided by any real awareness of the functional process of the voice. Relaxation pedagogy will only be effective if the student learns to tell the difference between functionally different ways of singing.
Relaxation techniques ideally enable the student to stop doing unnecessary things during the preparatory set and the act of singing. This achievement then frees the mechanism to operate efficiently and gives the singer a new awareness of how little effort is really needed to sing. This sensation may be unfamiliar and even unsettling, but it leads to real vocal growth. Relaxation procedures that produce better sounds but no kinesthetic insight leave the singer dependent on that procedure to recover the desired tone. Generalized relaxation directives often yield nothing more than a phlegmatic, de-energized tone.

Direct Control. Writers about the voice generally agree that direct control of the vocal mechanism is impossible. Direct control is usually used in the sense of conscious manipulation of specific laryngeal muscles. In Fields (1947) and Burgin (1973), annotated bibliographies which together review all books and articles written about singing between 1928 and 1942, numerous sources are quoted which agree that "in its normal functioning, the vocal mechanism is entirely automatic and should not be molested" (Fields, p. 33). The operant phrase in this statement, however, is "in its normal functioning."

People usually enter voice studios with voices that are not functioning normally. Teaching singing obviously requires imposition of some type of control. While this control is not direct in the ordinary sense mentioned above, the teacher is trying to draw the attention of the student to some particular concept or part of the body which he knows (or hopes) will serve as an
organizing principle and allow the total mechanism to function properly. If the singer's jaw is tense, the teacher will often work to release the localized tension even though he knows that the jaw tension is just a small part of the overall problem. Like a lumberjack trying to break up a log jam, a bewildering array of muscle tensions and imbalances can often be sorted out by prying free a key log which then indirectly liberates other parts of the system. This is true of the psychological as well as the mechanistic approaches to vocal pedagogy.

The point to be made is that teachers and singers do commonly use a kind of direct control when they focus attention on certain portions of the vocal instrument more than others. This process is guided by the visual, aural, and, especially for the student, kinesthetic senses. Commonly, a teacher will point out to the student a source of physical tension in the body and simply ask him or her to stop tensing that area before he or she begins to sing. The student is not asked to do anything, but only to keep from doing something harmful. This approach would normally be called an "indirect" method by voice teachers, but from the student's point of view it very definitely involves direct conscious action upon a certain part of the musculature. Vennard (1973) quoted Stanley (1933):

> An important fundamental principle in teaching voice is that direct control over any group of muscles in the act of phonation is impossible, while conscious control over groups of muscles activating members which should not be used in the act is possible of accomplishment [italics added]. Upon this fact and upon the psychological side of the subject rests the possibility of really training the voice. (p. 42)
Though the singer cannot deliberately choose the muscle balances involved in singing, he or she can, as it were, be consciously involved in what might be called "crowd control," a process of preventing unwanted things from getting in the way of right actions. As regards preparatory set, teachers often seek to prevent harmful preparatory behaviors by telling the student to refrain consciously from doing something during the inhalation. This process of "non-doing" is called inhibition, and will be discussed in a later section describing the Alexander Technique.

**Imitation and Shaping.** Most voice teachers recognize the value of providing aural models for their students. They either demonstrate for the student themselves or point to some other role model for the student to imitate. Demonstrative teaching is based on the idea of successive approximation: A learner masters a skill by progressing from initially rough-hewn efforts through a process of refinement.

This approach has a potential flaw, however, in light of the reflexive nature of preparatory set. Sweigard (1974) wrote that imitation learning "all too often builds up already established conditioned reflexes, regardless of their quality" (p. 166). The voice student understandably concentrates on matching the demonstrated tone quality without enough concern for how it is produced. The resulting phonation may sound correct but be functionally quite different.

For this reason, imitation learning in the voice studio cannot center around the sound itself. An experienced teacher usually pays
careful attention to the quality of the preparatory behavior used to produce the modeled tone. In helping the student analyze the demonstration, he or she draws attention to the postural alignment and pattern of inhalation which preceded the attack. The author's teaching experience indicates that tone quality improves most quickly when a student begins to concentrate on imitating proper preparatory coordination (rather than the sound itself).

**Spontaneity.** While learning by imitation in the voice studio depends on the ability of the learner to analyze a visual/aural model, another kind of approach seeks to elicit spontaneous changes in tone production which are unanticipated by the singer. Siren calls, coloratura patterns, and yodeling up into the upper register are common techniques which, in effect, fool the voice into producing sound in a different way. During normal vocalization, the singer's tone concept (the way he or she expects the tone to sound and feel) triggers a reflexive preparatory set, and inefficiencies in this set are automatically passed on to the phonation itself. Spontaneous techniques have the effect of by-passing these habitual mental and physical sets and introducing a novel tone quality or coordination.

The relationship between such an approach and preparatory set seems to have been expressed most clearly by Reid (1965). Reid stated that the goal of vocalization should be to elicit an entirely new kind of tone production which is a surprise to the student.

The vocal organs can be made to respond so as not to be a representation of the singer's preconceived mental picture, or, for that matter, even his aesthetic goals. The response
is spontaneous. It takes place without anticipation. It happens in spite of everything! (Reid, p. 199)

According to Reid, the only way to get in touch with fresh experience is to by-pass the habitual way of doing things. "Pre-formed concepts of quality, or romanticized ideals of timbre, must be ejected from the pre-concept" (p. 188). He argued that traditional imagery, such as "make the tone warmer," "focus the sound," "spin out the tone" and others are all interpreted by the student in terms of his or her own previous sensory experience and habitual preparatory set. The resulting tone production thus has little chance of being something truly different.

The spontaneous response, on the other hand, can sometimes provide an "sha" experience which becomes the basis of new awareness.

These movements...create new sensations to which relationships can be made. If the patterns set up are correct there should be a greater naturalness of response, a naturalness which the singer should be quick to perceive, and, even more importantly, learn to assist and prepare for mentally as a desired functional activity. (Reid, p. 191)

Gradually the singer develops an acute kinesthetic awareness of how natural voice production feels. This skill was regarded by Reid as "the highest form of 'knowing.' And it is tangible knowing, even though it must always be restricted to subjective knowing" (p. 199).

The Alexander Technique

The best introduction to the principles of the Alexander Technique has always been a description of Alexander’s own experience. The following narrative will be as brief as possible
and the reader is referred to other sources for more complete information. Alexander's own account of his experimental work on himself is found in *The Use of the Self* (1932). Other reliable descriptions are provided by Jones (1976), Lewis (1980), McCormack (1958) and Westfeldt (1964).

In the early 1890's Frederick Matchiss Alexander (1869-1955) was in the process of building a career as an actor, doing one-man recitations, mainly of Shakespeare, in Sydney and Melbourne, Australia. He was also teaching elocution and voice culture (McCormack, p. 14). Alexander's voice began to give him trouble during performances (though not during normal speaking) and would fail unexpectedly while he was reciting. Medical advice did not help. He tried complete vocal rest before performing but the symptoms reappeared as soon as he began to recite.

Faced with the loss of his career and unable to find anyone who could prescribe effective therapy, Alexander decided that a solution would have to come from his own observation and insight. He began to use a mirror to analyze his behavior during reciting. Through extraordinarily patient observation over an extended time, he found that he always did three things just before reciting: He depressed his larynx, audibly sucked air during his inhalation, and pulled his head back and down by lifting his chin. After lengthy experimentation, Alexander found that the change in head position governed the other two behaviors. When he could keep himself from pulling his head back and down, the depressed larynx and gasping inhalation disappeared.
Further investigation revealed that the movements of his head were linked with a comprehensive pattern of damaging preparatory activities which included lifting his chest, shortening his spine, and narrowing his back. Having concluded that his head position was somehow the source of the whole problem, he began to experiment with ways of controlling the movement of his head. He practiced first trying to prevent the old habit (pulling back and down) and then "directing" himself mentally to allow the head to move forward and up instead. While eventually able to do this as an isolated exercise, he found it impossible to maintain the new pattern in the context of actual reciting.

This failure made Alexander suspect that he was doing something wrong. Returning this time to a series of mirrors (he had stopped using his mirror after making his initial observations, reasoning that he had already discovered what he needed to know), he observed his actions carefully. The results shocked him.

For there I saw that at the critical moment when I tried to combine the prevention of shortening with a positive attempt to maintain a lengthening and speak at the same time, I did not put my head forward and up as I intended, but actually put it back. Here, then, was startling proof that I was doing the opposite of what I believed I was doing and of what I had decided to do. (Alexander, 1932, p. 10)

From this experience Alexander realized that his body's own sense of what it was doing had been distorted: His kinesthetic sense was an unreliable guide for directing movement. His strong habitual pattern of vocal use was not only overriding his best conscious attempts at change but was feeding him false kinesthetic information about the movement.
This stimulus to general wrong use was far stronger than the stimulus of my desire to employ the new use of my head and neck, and I now saw that it was this influence which led me, as soon as I stood up to recite, to put my head in the opposite direction to that which I desired. (Alexander, 1932, pp. 12-13)

It is important to make clear what Alexander learned from these observations. He had seen that the head/neck relationship not only governed the efficiency of his vocal production but influenced the overall pattern of muscular and postural use in his whole body. He had logically assumed that with enough practice he could train himself first to prevent his old habit from occurring and then consciously to direct a new one to take its place. This he did learn to do within an isolated context, but when he tried to use the inhibiting/directing procedure in connection with actual recitation, the old habit pattern reasserted itself. Further—and very importantly—Alexander was not even aware that it had done so. His kinesthetic sense was leading him astray.

Alexander eventually adopted the following procedure in his attempt to short-circuit the habitual response that always took over at the last critical moment. After deciding to, for example, recite a sentence, he would first inhibit any immediate response to the stimulus to speak. Second, he would project a series of mental orders to himself which included the direction to let his head move forward and up, his spine lengthen, and his back to widen. He would not actually perform these motions, but would mentally project the commands. All of these things he had done before, but at this point
he had been going ahead and doing the desired action. Alexander writes:

At this moment—the moment that had always proved critical for me because it was then that I tended to revert to my wrong habitual use—I would change my usual procedure and... while continuing to project the directions for the new use I would stop and consciously reconsider my first decision, and ask myself "shall I after all go on to gain the end I have decided upon and speak the sentence? Or shall I not? Or shall I go on to gain some other end altogether?"... and then and there make a fresh decision. (Alexander, 1932, p. 23)

By pausing at the brink of the chasm and consciously considering his choices as he continued to project the new directions, Alexander thought that he would be

subjecting my instinctive processes of direction to an experience contrary to any experience in which they had hitherto been drilled. Up to this time the stimulus of a decision to gain a certain end had always resulted in the same habitual activity involving instinctive directions for the use which I habitually employed for the gaining of that end. (Alexander, 1932, p. 24)

The new procedure worked. When he could focus his attention not on the end to be gained (the speaking of the sentence) but on the "means-whereby" (the continual sending of the mental orders and the fresh decision made at the last moment) Alexander found that he was at last able to break the cycle of his habitual response.

My instinctive response to the stimulus to gain my original end was not only inhibited at the start, but remained inhibited right through, whilst my directions for the new use were being projected. (Alexander, 1932, p. 24)

As he became accustomed to using this procedure he noted that not only his vocal trouble but long-standing respiratory and nasal difficulties disappeared.
Alexander's subsequent experience convinced him that movements tend to be crippled by the fact that we focus our attention on the final goal instead of the "means-whereby" (the process of achieving the product). Attending to a desired result (such as picking up an object) automatically triggers an habitual pattern of response. Only by deliberately choosing to ignore the "end" and attending to the intermediary means can this reflexive pattern be avoided. In addition, once a movement has begun the person must keep attending to the means instead of being distracted by the final goal. This continual awareness of the process gradually becomes the individual's habitual approach to all movement.

The key to this re-education process, according to Alexander, is the new head-neck relationship which he called the primary control. This relationship governs the integration of the body's postural reflexes (see Chapter II). After the teacher introduces the student to the kinesthetic feeling of this new head/neck balance, the student can then recognize muscle tensions which interfere with this freedom. Attending to the means-whereby in Alexander training is primarily a matter of allowing the head and neck to be free to move according to natural function. This freedom in turn produces improved coordination characterized by lighter, less effortful movements.

While Alexander made his discoveries without assistance from others, all recognized instruction in the Technique is now done by trained teachers. While this dependence may make some observers suspicious, it is really an extension of one of Alexander's basic
discoveries. As described above, Alexander was shocked when he learned that his kinesthetic sense was an unreliable source of guidance as to what he was doing with his head and neck. He related that he honestly thought he was putting his head forward and up when the mirrors revealed that he was doing exactly the opposite. He realized that his habitual actions had come to feel right to him simply because he had always done them that way.

As he began to work with students, Alexander discovered that he couldn’t simply tell them to stop pulling their heads and necks down and to do the opposite: Students were just as incapable of doing this as he himself had been. Instead, Alexander learned to use his hands to bring the student’s head and neck into the new relationship (release the "primary control"). In beginning Alexander training, the student is often instructed to do nothing, but merely to notice what the teacher is doing and not actively resist it. In this way, the teacher imparts a novel kinesthetic experience which the student would probably never discover on his or her own, primarily because of the unreliable information supplied by the kinesthetic sense.

The beginning Alexander student is thus very dependent on the teacher. Left alone with, say, a book of "Alexander exercises" to follow, the student would be unlikely to overcome the overwhelming power of his or her inefficient movement habits. The changes which would be tried would probably be, as John Dewey (1930) said, "only a different kind of badly" (p. 29), since they would still be tied to old habits.
As time goes on, however, dependence on the teacher gives way to an internalized kinesthetic awareness. The Alexander student learns to restrain habitual anticipatory actions, project the mental commands, and exercise conscious control over common movements. He or she learns to remain aware of the means rather than the ends, and to avoid being led by familiar feelings. The new process becomes more and more automatic and the teacher becomes a source of further refinement and encouragement.

Because of its focus on influencing habitual motor responses at their source, the Alexander Technique may be particularly useful in dealing with problems of inefficient preparatory set in singing. As discussed earlier, the muscle/posture patterns which a singer adopts before phonation are unconscious, reflexive responses to the stimulus to sing. Alexander training first enables the student to consciously observe these responses (through increased kinesthetic awareness) and then provides a way to change them through the exercise of inhibition and the freeing of the primary control. The new habits which result are not only more efficient but can be "edited" much more easily since the student has become kinesthetically sensitive.

Though this research considered the Alexander Technique in connection with preparatory set, Alexander's work should be seen in its larger context. Alexander was interested in achieving a comprehensive re-education of the entire approach to activity, both mental and physical. While teachers and students of the Alexander Technique invariably notice improvement in the type and organization
of preparatory behavior, these changes are but outcomes of more basic discoveries.

**The Alexander Technique: Further Definition by Comparison**

Earlier, four vocal pedagogy techniques were outlined: relaxation, direct control, imitation, and spontaneity. The following section offers further discussion of each of these approaches in connection with the important concepts of the Alexander Technique. It is hoped that this material will lead to more accurate understanding of both the Alexander Technique and the whole subject of preparatory set in singing.

**Relaxation and Inhibition.** As discussed earlier, the goal of relaxation techniques in the voice studio is not indiscriminate collapse of the vocal mechanism. Singing requires a finely tuned, dynamic balance of forces. Ideally, relaxation techniques should produce a calm, confident mental state which manifests itself in an improved overall balance of muscular activity and posture.

Relaxation is a preparatory activity in which the singer gets ready to sing by saying "no" to various kinds of mental and physical static that would interfere with vocal freedom and artistry. When a teacher tells a beginning vocal student to relax, he or she is using a "shotgun" approach: The offending muscles relax but so do others which should not have done so. To the more advanced student, however, relaxation means something more specific. He or she knows what to relax and what not to relax. This selective relaxation permits a more efficient application of physical and mental energy.
This selective relaxation requires a high level of skill and kinesthetic awareness. As vocal technique becomes more sophisticated, the artist may come to realize that he or she only needs to avoid some particular behavior while preparing for the attack. The actual doing of the singing itself is entirely automatic, provided the singer quietly and accurately says "no" to some old habit pattern. This selective relaxation is related to the concept of inhibition as used in the Alexander Technique. Jones (1976) said that "inhibition maintains the integrity of the responding organism so that a particular response can be carried out economically without involving inappropriate activity in unrelated parts" (p. 149).

Jacobson's Progressive Relaxation (1938) was the basis for the relaxation training in this study. Cratty (1973) said that Jacobson's technique allows a person to "recognize and to control minute amounts of tension in his body and to reduce residual tension to a minimum" (p. 311).

The link between progressive relaxation and the idea of inhibition is contained in the words "recognize and to control." The experienced singer kinesthetically recognizes interfering tensions and learns to calmly inhibit them. Jacobson called this differential relaxation.

The idea of inhibition, or non-doing, is prominent in Eastern philosophy. In Herrigel's well-known Zen in the Art of Archery (1953), the master archer advises his confused occidental pupil:

Don't think of what you have to do, don't consider how to carry it out...the shot will only go smoothly when it takes
the archer himself by surprise. It must be as if the bowstring suddenly cut through the thumb that held it. (p. 31)

The oriental martial and fine arts are in large part expressions of this Buddhist thought, that the natural, beautiful or powerful emerge automatically when the doer becomes disengaged from active involvement with the task. This is clearly related to the ideas of selective relaxation and inhibition. By clearing away extraneous activity, we leave room for a more efficient response to occur.

Though there are similarities between the Alexander Technique and the ideas just described, important differences do exist. Both approaches agree that the essential problem is the stimulus/response connection between the desire to do something and the automatic reflexive response. Eastern thought generally seeks to break this link by eliminating the desire, and relaxation training is essentially passive in nature. In both, the emphasis is on inhibition rather than action. In contrast, Alexander training, though it uses inhibition, introduces a consciously controlled sequence of means, each of which is dealt with in its proper order while the others are kept in operation also.

Furthermore, both relaxation techniques and Zen operate from the assumption that the reflexive response (once freed from conscious interference) can be trusted. Alexander's work led him to the belief that habitual patterns of misuse would always reassert themselves without conscious intervention and systematic re-education. Alexander insisted that preventing the incorrect response through inhibition was only half the answer: Successful
re-education depends on restoring the integrity of the specific head/neck balance that he called the primary control.

**Direct Control.** Earlier, it was argued that any kind of dependable singing technique has to be the result of a type of direct control, in the sense that the singer is following a consistent set of procedures based on kinesthetic awareness. The singer does not leap into the darkness every time he starts a pitch. He or she does certain things in certain ways and avoids other actions or thoughts. This is certainly a direct control, but it is general rather than specific.

The singer knows he or she is ready to sing when the overall pattern of kinesthetic sensation feels right. This is not perceived in terms of individual muscles but as an integrated whole. The singer's sensitivity to his inner state is, for him or her, a very real kind of direct control.

One of the most basic principles of the Alexander Technique is the recognition that the organism functions as a whole. Activity is integrated and mediated through a "primary control," the relationship of the head, neck, and spine. Alexander felt that most traditional physical training methods were doomed to fail because they fragmented the organism by manipulating the parts without reference to the whole. Such attempts at direct control were, in Alexander's view, useless. He labeled them "end-gaining."

Alexander training does, however, establish a very definite kind of direct, conscious control, as can be seen from the description of Alexander's own step-by-step procedure. The difference is that this
direct control is derived from a more organized and inclusive field of kinesthetic awareness.

Imitation and Shaping. A weakness of imitative learning is that the learner can only perceive and imitate the external characteristics of a modeled behavior. The model's internal coordinative arrangement cannot be seen. The student may produce an imitation which seems to perfectly match the model but which is functionally different. The burden is on the teacher to continue to refine and vary the models until the internal coordination of the student is correct.

From an Alexandrian's viewpoint, the use of visual or aural models inadvertently encourages the learner to duplicate outward characteristics without encountering the underlying function. While students who possess some kinesthetic sensitivity may be able to put the pieces together, many students will not be able to discern the internal organizing principles which are operating in the model.

Unlike imitative learning, the Alexander Technique works from the inside out. The teacher conveys to the student a first-hand kinesthetic experience of a truly free head-neck-spine balance. This novel sensation forms the basis for subsequent evaluation of movements.

Spontaneity. When an Alexander teacher alters the head-neck balance of a student for the first time, the student usually experiences a strong, unanticipated lightness and ease during movement. This kinesthetic contrast makes it clear how much unnecessary effort had previously been used, and the freer, lighter
sensation becomes the standard by which future movements are evaluated. This is very similar to the concept of spontaneity as described by Reid (1965). As in the Alexander Technique, Reid’s approach depends on bypassing the habitual response and providing the singer with a new kinesthetic/aural experience. While the teacher will of course reinforce this new production, it is interesting to note that such an experience is essentially self-reinforcing because it produces a "greater naturalness of response, a naturalness which the singer should be quick to perceive, and, even more importantly, learn to assist and prepare for mentally as a desired functional activity" (Reid, 1965, p. 191).

Alexander students usually express pleasant surprise when they first feel the new head-neck balance because they instinctively sense that it is right. The initial spontaneous experience instantly enlarges and reorganizes their field of awareness. In the same way, a singer who is "fooled" into producing a truly free tone for the first time suddenly possesses a wealth of new kinesthetic information. The direct imparting of such first-hand kinesthetic experience has obvious advantages over verbal descriptions, relaxation techniques, or demonstrative teaching.

Summary

Following an introduction to the study, this chapter has provided the reader with information on the nature of preparatory set. It was argued that preparatory set is a complex psychomotor phenomenon which operates reflexively in connection with an
individual's habits and expectancies. Citations from the vocal pedagogy literature demonstrated that voice teachers implicitly recognize the importance of preparatory behavior in tone production. Four common teaching approaches were discussed in terms of their relationship to preparatory set. The Alexander Technique was presented through a description of Alexander's own experiences and a comparison of his ideas with each of the four teaching approaches.
Chapter II
Review of Related Literature

**Kinesthesia--The Body's Awareness of Itself**

Two words, kinesthesia and proprioception, are used to describe the sense by which animals know where they are in space and gauge muscle effort. Proprioception is the more comprehensive term because it includes input from the vestibular mechanism as well as that from muscular, tendonous and articular sources. Kinesthesia generally refers only to sensory awareness derived from receptors in muscles, tendons and joints. The term proprioception is thus favored in the physiological literature while kinesthesia appears more in psychological writings (Dickinson, 1976).

Prior to the nineteenth century, kinesthesia had not been investigated from a physiological point of view. Writers vaguely proposed the existence of an actual intelligence located within muscles or the spinal cord, a so-called "muscle sense" (Fearing, 1964). Bell (1833) first postulated the existence of the neurological feedback loop, stating that "between the brain and the muscles there is a circle of nerves; one nerve conveys the influence from the brain to the muscle, another gives the sense of the condition of the muscle to the brain" (p. 129).

Though research through the second half of the nineteenth century saw the identification of the various kinesthetic sense
organs within the muscles and joints, it was Sherrington (1906), the father of modern neurophysiology, who conclusively showed that these tiny intermuscular sensors send a constant stream of afferent (sensory) information through complex spinal reflex arcs. Subsequent neurological mapping (Dickinson, 1976; Fearing, 1964; Sherrington, 1906) has revealed an intricate system of interdependent reflexes which is responsible for movement control and the maintenance of posture. The entire system is dependent on kinesthetic feedback from within the muscles and joints themselves. Duncan (1971) assembled a thorough review of research literature on kinesthetic sensitivity.

Detailed description of these kinesthetic reflex systems is unnecessary here, but a few facts will be reviewed below in order to make several observations which are pertinent to this study. Muscle spindles, the kinesthetic sense organs located within the fibers of voluntary muscles, fire (send nerve impulses to the spinal cord) only when the host muscle is stretched (Sherrington and Lidell, 1924). In response, a reflex arc automatically causes the muscle to contract in order to resist the stretch perceived by the spindles. Another simultaneous arc instantly signals the muscle's antagonist to stop contracting, an inhibitory response. This arrangement protects the muscle against damage. Another type of sense organ, however, the Golgi tendon organ, responds only when its host muscle contracts. The spinal column responds to this information by signaling the host muscle to stop contracting and by initiating a
balancing contraction in the muscle's antagonist (Granit, 1955; Sherrington, 1906).

Though the spindles and Golgi organs appear to be functioning at odds with each other, the central nervous system prevents muscular grid lock through a process called **reciprocal inhibition**. Though different kinesthetic sensors actually send conflicting messages (one directing the host muscle to contract and the other demanding that it relax), the brain stem effortlessly prioritizes this input and suppresses the reflexes which need to get out of the way of other commands. Smoothly coordinated movement, then, depends largely on the application of the principle of inhibition at the autonomic or non-conscious level (Dickinson, 1976; Granit, 1955; Matthews, 1964). As will be seen, inhibition plays a large role in conscious movement control as well.

Since muscle spindles (the most common and important of the kinesthetic sense organs) only fire when the muscle is stretched, they stop functioning during active contraction. This would result in a loss of kinesthetic sense from the spindles if it were not for the fact that they can re-calibrate themselves to compensate for varying degrees of muscle tension. At its normal resting length, a muscle spindle can only be stretched so far before it reaches its limit and stops firing. But the spindle possesses its own independent muscle fibers. By contracting, these fibers shorten the spindle and allow it to continue firing even within a somewhat contracted host muscle. These interfusal muscle fibers are ennervated by an independent motor nerve supply called the **gamma**
**efferent system** (Leukei, 1972; Magoun, 1963). Continued firing of the recalibrated spindle of course causes the reflexive contraction of the host muscle to continue as well. The gamma efferent system operates as a servo mechanism, indirectly influencing the contraction of muscles (Buchanan, 1961; Dickinson, 1976; Magoun, 1963).

The discussion above provides some insight into the variability of kinesthetic sensitivity. In addition to differences between individuals, a single person may be quite sensitive to tension in one part of the body and oblivious to it in some other part. The receptor organs within a particular muscle adjust their sensitivity to contraction or stretch in response to the muscle's habitual tension level. These varying firing thresholds produce differing levels of sensitivity to changes in the muscle. The receptor organs can clearly be re-calibrated to provide greater sensitivity by allowing muscles to operate nearer to their optimum resting length.

There is some evidence (Buchanan, 1961; Howard and Templeton, 1966) that the body may rely on the normal motor nerve system during well-practiced movements but enlist the aid of the gamma efferent system for exploratory or tentative movements or those which involve delicate maintenance of postural balance. Based on a review of human performance studies, B. Jones (1974) theorized that proprioceptive feedback is used primarily during the learning of skilled tasks. Well-learned activities are controlled by a central record or "efference copy" of the movement which is stored in the central nervous system. This theory would seem to be supported by
the fact that proprioceptive feedback loops are too slow to monitor fast movements (Lasheley, 1951; Watz, 1975). Related to this, physical education research indicates that speed rather than accuracy should be emphasized during the learning of complex skills (see Bucher, 1975, p. 300).

**Conscious Kinesthetic Awareness**

The reflexes discussed so far are mediated through the autonomic central nervous system. Conscious kinesthetic awareness occurs when the raw sensory information makes its way into the higher brain levels through a hierarchy of intermediary mechanisms. Most of the nerve fibers coming from the kinesthetic sense organs terminate in the cerebellum, though some do extend into the cortex itself (Cranit, 1977). The cerebellum is largely responsible for coordinating reflexive and voluntary movements. The cerebellum "issues reports" to higher brain levels, notably the reticular formation. Dickinson (1976) notes that the reticular formation possesses a "tonic inhibitory mechanism" which enables it to decrease the apparent sensitivity of sensory mechanisms....In terms of proprioceptive information which is transmitted to the cortex, the role of the reticular formation is critical for perception to result from these impulses. Facilitation may cause increased sensitivity to this information and inhibition render perception less probable. (p. 31; see also Magoun, 1963)

In addition to being able to stimulate activity in the cerebellum, the reticular formation can itself be aroused by the cerebral cortex. "In this way cortical control over level of
arousal or over the facilitation of particular sense inputs may be
the physiological basis of selective attention" (p. 31).

Sherrington (1906) demonstrated that if an animal's brainstem is
severed so that the spinal cord is cut off from the influence of
higher centers, all the animal's extensor muscles go into a state of
hypertonicity called decerebrate rigidity. This indicates that the
main function of higher brain levels in postural control may be to
inhibit activities of lower brain levels which would otherwise "run
wild" (Dickinson, 1974; Leukel, 1972; Schneider and Tarshis, 1975).

In summary, conscious kinesthetic awareness is the result of an
incredibly complex processing of afferent neural impulses involving
many parts of the brain. The cerebellum is the primary processing
center for kinesthetic data, and it reports to higher centers in the
reticular formation and motor cortex. It appears that the reticular
formation then plays an important role in either facilitating or
inhibiting conscious kinesthetic awareness. It is clear that
kinesthetic sensitivity can be influenced by arousal mechanisms
within the brain. Conscious kinesthetic information seems to be
used to inhibit unwanted reflexive responses.

Studies of Preparatory Set

Evarts, Shinoda, and Wise (1984) reviewed the history of the
study of preparatory set. They quoted Ladd and Woodworth (1911, p.
470) as stating that by the turn of the twentieth century "many
thousands of experiments" had been made on the subject. This body
of research generally examined set indirectly through tests of
reaction time (See Duncan, 1971 for a review of reaction time literature relative to kinesthetic awareness). Such tests are based on the assumption that a faster reaction time indicates a more efficient preparatory set.

Mowrer (1938) examined the relationship between preparatory set and learning in connection Thorndike's laws of exercise and effect. He argued that, as a subject waits for an external stimulus, there is a steady rise in anticipatory psycho-motor tension. When the reaction is finally triggered, this state of tension is relieved. If the reaction is reinforced (either from the outside or by the person believing the reaction was "right"), learning occurs. The preparatory set is thus a source of motivation; animals react to stimuli in order to reduce their state of anticipatory tension. "It is conjectured that the occurrence of the response for which a preparatory set is specifically appropriate...normally reduces the tensions of which this preparatory set is composed" (p. 77). Mowrer further contended that when preparatory sets are excessively intense, "i.e., when they are not significantly diminished by the reactions which they help to produce, one observes, not learning, but the ultimate demoralization of behavior and frequently some form of 'nervous breakdown'" (p. 77).

Hebb (1972) stated that set always involves two factors: the present state of readiness of the individual and the specific stimulus which causes overt action. In a verbal math quiz, hearing the numbers "8" and "2" produces a preliminary expectancy, but it is only when we hear the command "subtract" or "add" or "multiply" that
a response occurs. Response time may be longer for the "multiply" command than for the "add" command. In spite of the huge body of literature derived from reaction time experiments, little research has attempted to understand the relationship between the pattern of preparatory activity and the quality of the eventual performance. Since preparatory set is largely unobservable, behavioral-oriented taxonomies of psychomotor learning have regarded it as a black box. In Harrow's taxonomy (1972), the author commented on a previous hierarchy developed by Simpson (1966):

The first two levels, taking the learner from stimulation to stimulus interpretation through set or readiness for response, are not readily observable behaviors. The next three levels [guided response, mechanism, complex overt response] can actually be categorized as a learning sequence inherent in many motor skills (p. 23, 24).

The inference seems to be that the preparatory, pre-mechanism stage of movement is less important.

A number of researchers have investigated the phenomenon of subliminal, covert muscle activity which precedes movement. Jacobson (1938) found that when subjects were asked to visualize the performance of a familiar task without actually doing it, faint but clearly patterned activity appeared in the muscles associated with the task. Holdsworth (1974) used EMG to study covert neuromuscular responses to musical stimuli. He found that as trumpet players saw or heard musical stimuli for which they possessed performance skills, flexor muscles of the right forearm (those controlling the fingers that operate the trumpet valves) were activated, even when the subjects were not aware of such activity. Holdsworth's paper
included a thorough review of research dealing with covert muscle activity during mental rehearsal of speech.

In a pioneering study, Belenki, Gurfinkel, and Paltsev (1967) identified postural EMG activity prior to and during voluntary movements of the upper limb. Marsden, Merton, and Morton (1977) found that load changes on the arm are anticipated by very early postural adjustments which take place not only in the vicinity of the arm itself but in distant locations. Bouisset and Zattara (1981) examined preparatory postural activity which occurred in anticipation of various body movements. Using EMG, they identified patterns of movement, stating that "anticipatory postural movements are directly opposed to [the direction of] the effect of the forthcoming movement" (p. 269). Pre-programmed responses distributed body weight so as to maintain balance during the particular activity. A further observation was that preparatory set serves to overcome inertia.

In a later study, Bouisset and Zattara (1987) determined that anticipatory postural adjustments are not random but are reproducible within a given experimental situation. "This could be considered as evidence of a precise nervous organization which integrates the bringing of both passive forces and active forces into play as early as the anticipatory period" (p. 739). Their study suggested that "voluntary movement and its associated anticipatory adjustments are parts of the same motor program" (p. 740). Friedli, Hallett, and Simon (1984), noting that preparatory processes for voluntary motor activity have received too little
attention, found that preparatory postural adjustments began prior to activity in the arm muscles being tested and that the anticipatory behavior and postural set were specific to the experimental task.

Thomas and Bull (1981) investigated postural changes that occur just before speech. The research showed that prior to a person speaking, he or she would make a characteristic movement, moving perhaps the head or some other part of the body; the movement being specific to the type of speech it preceded. (p. 105)

It should be remembered that Alexander's first observation was that he moved his head and neck in a particular way just before reciting. In the quote above, the phrase "type of speech" refers to the emotional content or emphasis of the intended phonation. Teachers of singing note that singers often use characteristic bodily movements in preparation for expressing certain types of emotion.

Singer (1972) notes that research in the field of traditional physical education has been almost exclusively physiological. Investigation of psychomotor factors which would be related to preparatory set are infrequent. Indeed, a review of a number of physical education texts turned up only one reference to "performance set" in Cratty (1973). Cratty, in explaining why excess tension impairs athletic performance, vaguely suggests that there is an "optimum tension level" for every activity.

In contrast to this lack of attention by American physical education researchers, Soviet bloc sports medicine boasts a large body of research literature on the nature of preparatory set and its
effect on athletic performance. Genov (1970), a Bulgarian, reported on 10 years of research involving more than 2000 Olympic-class athletes. Genov's term mobilization readiness seems to be synonymous with preparatory set.

All this permits us to consider the state of mobilization readiness as...a total state before the execution of an action. In this total state we distinguish three basic components: psychic, biological, and motor. These three components are reciprocally bound and conditioned, i.e., the good state of one reflects positively upon the others and vice versa. (p. 209)

A paper by Duarte (1981), discussing the relationship between preparatory set and singing, will be described later in this chapter in the section dealing with studies related to singing (p. 80).

Non-traditional Approaches to Movement Control

While conventional physical education texts either ignore preparatory set or subsume it under the general headings of "arousal", "attention," or "task-attitude," there are other more esoteric approaches which address set more directly. As does the Alexander Technique, these movement education philosophies place greater stress on the close connection between body and mind, between the mental conception of a movement and the movement itself. Such a starting point automatically involves consideration of habitual preparatory set.

Thornton (1971) may exaggerate a little in stating that the work of Rudolf Laban (1879-1958) "is recognized as the first systematic study of movement and is the source from which most major movement developments have stemmed" (p. 115). This distinction must
surely be given to Delsarte (1811-1871), whose pioneering work was carried on by many disciples (see Brown and Sommer, 1969 for a review). Nonetheless, the sweeping changes that occurred in English school physical education programs following World War II were largely the result of the dissemination of Laban's ideas about movement education (Bucher, 1975; Thornton, 1971). Laban taught that movement "is the link between man's intentions and their realization through action... between the covert and overt behavior of man." (Thornton, p. 33).

In contrast to its normal use, Laban used the term effort to describe the inner psychological impulse which gives rise to movement (Brown and Sommer, 1969; Thornton, 1971). All physical movements are thus derived from and connected to this effort state, and Laban analyzed them in terms of four variables: weight, space, time, and flow. He observed that, since the internal effort state tends to be constant, very different movements by the same person usually display common characteristics. Further, individuals are not generally aware of the operation of these underlying habit patterns. In his teaching, Laban attempted to break down these limitations by making people kinesthetically aware of their own movement patterns (Thornton, 1971).

Feldenkrais training is a very popular movement education approach which, like the Alexander Technique, has gained enthusiastic supporters among musicians. In his writings and teaching (1972), Moshe Feldenkrais emphasized the need for heightened kinesthetic awareness and conscious inhibition in order
to interrupt and then retrain habitual preparatory sets. To get up out a chair, Feldenkrais (1972) advised the student to "halt the intention to get up and see what part of the body relaxes as a result. This is the effort that was superfluous to correct getting up" (p. 80).

Feldenkrais recognized the existence of postural mechanisms which need to be liberated from habitual interference, but his method contained nothing analogous to Alexander's primary control, the discovery which lies at the heart of the Alexander Technique. Despite this fundamental difference, many of the ideas and terms found in Feldenkrais' writings are strikingly similar to those of Alexander. This may largely be due to the fact that Feldenkrais studied under Charles Neill, a student of Alexander's (W. G. Conable Jr., personal communication, May, 1988).

While neither Emil Jaques-Dalcroze nor his disciples used the term, the concept of preparatory set is clearly present in the philosophy underlying Eurhythmics. Jaques-Dalcroze (1918) saw that efficient physical movements are related to the quality of the performer's mental conception. Poor rhythmic sense is "caused by the lack of balance between the mental and physical powers, which results from insufficient co-ordination between the mental picture of a movement and its performance of the body" (Jaques-Dalcroze, 1918, p. 30). Referring to these mental images, Ingham (1918) stated that:

> these movement images store up the innervations which bring about the actual movement. They are for the body and its movements what formulae are for the mathematician....Thus the pupil who knows how to march in time to a given rhythm has
only to close his eyes and recall a clear image of the corresponding movements to experience the rhythm as clearly as if he were expressing it by marching (p. 40).

If mental images "store up the innervations which bring about the actual movement," it would seem that Eurhythmics is somehow concerned with influencing the reflexive psychomotor patterns we have been calling preparatory set. Unlike the Alexander Technique, Jaques-Dalcroze's system does not view active, conscious inhibition as a necessary step in the educational process: The emphasis is on active movement. Nevertheless, the principle of inhibition based on increased kinesthetic awareness is obvious in the following statement: "The aim of all exercises in Eurhythmics is to strengthen the power of concentration, to accustom the body to hold itself in readiness [italics added] to execute orders from the brain" (Jaques-Dalcroze, quoted without citation in Rosenstrauch, 1973, p. 13).

In introducing his movement education system called "Body Wisdom," Arthur Lessac (1978) stated that increased kinesthetic awareness makes it possible to recognize and retrain habitual patterns of movement:

It is possible to establish a foundation of reawakened awareness by which our habit-formed patterns can be de-patterned. That is to say, the awareness will catch those habits in the act; challenge them, redefine them, refamiliarize us with them, make them fluid, and return them to our creative resource(s). Flexibility thus induced, the "habit" is neutralized, negated, and we are then able to respond to internal cues and signals that guard against unbalanced, unnecessary erosion. A habit ceases to be a habit the instant one is aware of it-in use. (p. 6)
Sweigard (1974) developed a system for achieving improved skeletal alignment based on "ideokinesi..." or the mental visualization of movement using creative imagery:

When postural alignment is poor the basic neuromuscular habits are inefficient and become a handicap to good movement....Imagined movement... is based on the premise that the central nervous system will pattern subcortically the muscle action which will obtain the visualized goal of movement in only one way, namely the most efficient way for the purpose. It can only do this when voluntary aid is not imposed. (p. 224)

Since the voluntary thought automatically triggers the habitual preparatory set, indirect control is achieved through the use of imagery.

Physiological Studies Relating to the Alexander Technique

Sherrington's research on reflexes using spinal and decerebrate animals stimulated the work of Rudolf Magnus, who studied with Sherrington in 1908. Magnus later carried out exhaustive experiments at the University of Utrecht which culminated in his book Koerperstellung (1924). Magnus observed that the position of an animal's head in relation to space and to the rest of its body seemed to play a central role in coordinating other reflexive actions. Magnus found that even the decerebrate animal (with its complete hypertonicity of the extensor muscles) will adopt different physical attitudes if the position of its head is changed. Magnus and his colleagues showed that this is the "result of combined action of two sets of reflexes, "tonic labyrinthine and tonic neck reflexes acting on the body muscles" (Magnus, 1925, p. 343). They
were able to study each of these reflexes in isolation by surgically eliminating the other.

The tonic neck reflex is stimulated as twisting or flexing of the neck activates proprioceptive organs in the "deep structures of the neck" (Magnus, 1925, p. 343). These receptors were identified by McCouch, Deering and Ling (1951). Granit (1970) said that the neck muscles contain more muscle spindles than almost any other part of the body. He cited Cooper (1966) to the effect that "the muscles richest in spindles are the deep ones connecting the vertebral column with the head which have 'a bewildering number of spindles'" (Granit, p. 54).

Thus, when the position of the neck is even slightly altered, the limbs reflexively assume a new balance and tonus. Magnus found that this state is not subject to fatigue, lasting as long as the head and neck remain in the same position. He was eventually able to predict accurately the postures that would occur in response to specific movements of the head.

Magnus' research focused on two types of reflexes: attitudinal, and righting or postural. When a cat sees a mouse, it immediately turns its head toward the prey. This primary response stimulates the kinesthetic organs in the neck which trigger a "domino effect" in the rest of the cat's body, getting it ready to pounce. The righting reflex of animals operates on the same principle: The animal returns to its normal resting posture from an abnormal posture (such as being dropped upside down by a careless child) by first re-orienting the head. This triggers a comprehensive righting
reflex. Posture is maintained by the combined activities of the
tonic neck reflex, tonic labyrinthine reflex, and visual input.
Magnus also noted that the body possesses back-up systems which in
some cases can overcome the loss of specific sensory modalities.

Magnus' work was with animals. He stated (Magnus, 1926) that
"the study of righting reflexes in man is still in its infancy" (p.
588). While the same reflexes exist in man, they are hard to detect
because of the influence of conscious volition and habit. Magnus
cited the golfer's swing (an illustration also used by Alexander,
1932, pp. 32-44) as an example of a tonic neck reflex in action.
The golfer learns to fix the head in the line of sight of the ball.
This facilitates and strengthens the extension of the left arm and
the twisting of the body (Magnus, 1925, p. 346). In general,
however, normal activity involves a multilayered web of reflexes and
habits which defy simple analysis. Still, the position of the head
and neck in relation to the rest of the body acts like a mode
determiner, influencing how stimuli will be transformed into motor
output.

One and the same stimulus applied to one and the same place
on the body may give rise to very different reactions, in
consequence of different attitudes which have been imposed on
the body before the stimulus is applied. (Magnus, 1925, p.
346)

Tokizane, Murao, Ogata, and Kondo (1951) confirmed the existence
of tonic neck reflexes in normal human adults. They also reinforced
the concept that the postural reflexes are controlled in man through
inhibition from the cortex.
For both Alexander and his supporters, Magnus' work seemed to provide experimental support for the existence of the primary control, the head/neck relationship which, in Alexander's view, determined the freedom and efficiency of voluntary movement. Most notable of these supporters was John Dewey, who referred to Magnus in his "Introduction" to Alexander's book *The Use of the Self* (1932).

The claim that Magnus' *Zentralapparat* was equivalent to Alexander's primary control was disputed by some contemporary British medical doctors. Jones (1976), in discussing this disagreement, argued that the objections were based on semantics. Alexander was not an anatomist and never claimed to have discovered an anatomical center for movement control. Jones stated that Alexander's discovery and Magnus' research are in agreement on the common ground of function, inasmuch as the head and neck do indeed integrate the body's postural reflexes.

While there is no evidence that Magnus ever learned of Alexander, the eminent biologist George E. Coghill endorsed the Alexander Technique, writing an "Appreciation" for Alexander's book *The Universal Constant in Living* (1941). Coghill's life work was the study of the neurological development of lower vertebrates, specifically a species of salamander called *amblystoma*. His research looked for links between the development of anatomical structure and the appearance of specific behaviors (Jones, 1976). Forty years of study led Coghill to the conclusion that, in the developing organism, movement patterns first appear in the head and
neck and move from there in an ever-expanding pattern throughout the rest of the body. He discovered that overall patterns of movement were dependent on the interaction of opposite factors, "one overt and excitatory and the other covert or inhibitory" (Herrick, 1949, p. 107).

Alexander met Coghill in 1941 and gave him several lessons in the Technique. Coghill was very ill at the time and in fact died within several months. He was sufficiently impressed by the Technique to write the "Appreciation" mentioned above. He states that Alexander's work "is founded, as I understand it, on three well-established biological principles." These are:

1. The quality of integration of the whole mechanism is reflected by the performance of particular functions.
2. Proprioceptive sensitivity influences posture.
3. Posture is primarily responsible for determining muscle action. (Maisel, 1974, p. 185).

Coghill's comments support several of Alexander's most basic tenets: the unity of function of the entire body, the importance of proprioceptive awareness, and (by implication) the existence of a primary control which governs coordinated movement.

Frank (1938) conducted a study of neonatal development in which she examined photographs of very young children in various positions. When a child was placed by an adult in a position which it could not assume by itself, muscle tone and spine configuration were markedly different from conditions in normal positions. Frank presented this as evidence that when an infant chooses its own movement patterns it uses comprehensive motor programs that produce
efficient muscle use and skeletal alignment. Positions induced from the outside bypass these programs and force the child to use awkward muscle and postural forces to maintain the position.

After citing Coghll's work, Frank described the Alexander Technique. Her conclusion was a statement of Alexander's theory that body "misuse" begins to be learned at a very early age. Children start off with unencumbered postural mechanisms but quickly start imitating their parents. Frank's paper seems to have been written to support the concept of adding the Alexander Technique to elementary school curricula, an idea vigorously promoted by Alexander himself.

**Studies of the Alexander Technique**

**The Work of Frank Pierce Jones.** Most of the existing research on the Alexander Technique was carried out by Frank Pierce Jones at the Institute for Applied Experimental Psychology at Tufts University. Jones was a teacher of the Alexander Technique, having studied with both F.M. Alexander and his brother, A. R. Alexander. John Dewey encouraged Jones to conduct experimental studies on the Technique. Like others who were interested in promoting Alexander's work, Dewey believed that the subjective benefits of the Technique needed to be supported by a body of experimental research. Jones, working with various collaborators, published 16 papers between 1951 and 1972. Of these, eight are reports of studies that directly involve the Alexander Technique. Others are either supportive studies or descriptions of experimental equipment. Jones used
surface EMG in three of the studies and spectrographic voice recording in one study, but his preferred method of data collection was stroboscopic photography. This technique yielded time exposure photographs of movements which allowed him to accurately trace the trajectories of various points on the body as well as to calculate speed of movement and rates of acceleration.

The most common behavior studied was the sit-to-stand movement, although many other everyday activities were also examined. In its most basic form, Jones' protocol had subjects adopt their ordinary posture and then perform a certain movement. He would then use the Alexander Technique to alter the head-neck balance and the movement would be repeated. Analysis of the photographs would show that movements were performed in a very different way under the Alexander influence. The trajectory of the head was higher, smoother and straighter. Movements took place faster. Subjects reported that the "guided" movements were accompanied by "a kinesthetic experience of lightness and ease of movement" which tended to "persist after the experimental session is concluded" (Jones, 1965).

The following is a brief description of each of the Jones studies except one. Jones (1972) is discussed on page 68 since it concerned singing.

Jones and Kennedy (1951) used surface EMG to study the "startle pattern," the reflexive hunching of the shoulders and throwing forward of the head that occurs in response to sudden noises. Though the test involved only eight subjects and was not a controlled study, data indicated the startle response consisted of a
progression moving from the head downward into the rest of the body. This is in keeping with the findings of Magnus and Coghill, described above.

Jones and Narva (1955) recorded the head, arm and lower leg trajectories of several male subjects. Photographs were taken of three activities: straightening up from a relaxed position, moving into an upright seated position from one leaning forward, and standing up from a seated position. Subjects did each of these movements from two different postures: "most relaxed" and "guided" (with Jones applying Alexander assistance). The authors noted that the guided posture resulted in a greater distance between the occiput and the seventh cervical vertebra (a longer neck). Several photographs of one subject appear, but no data are given.

Jones and O'Connell (1956) and Jones, O'Connell, and Hanson (1958) are merely descriptions of the stroboscopic photography technique. Jones and O'Connell (1958), in another descriptive report, showed how angles between specific points on the subject's body (those marked with the reflective material) were used to compute three relationships: the position of the subject's head relative to the ground, its angle of rotation around a transverse axis, and its position relative to a plane drawn through the seventh cervical vertebra.

Jones, Cray, Hanson, and O'Connell (1959) used six male undergraduates enrolled in voice and diction classes. Eight stroboscopic photographs were taken of each subject as he stood up from a seated position. Four trials were done using the subject's
"habitual" posture. The four others involved the use of the Alexander Technique, but in two Jones merely "adjusted" the postural balance of the subject and then let him get up by himself. In the other two, Jones first altered the head balance as before but then instructed the subject: "Leave your head as it is. Don't make an effort to move. I'll start the movement for you." Jones then applied just enough upward pressure to initiate the movement. Following this testing, the subjects met individually with Jones for training in the Alexander Technique (20 biweekly sessions of about 1/2 hour each). Posttesting duplicated the pretest conditions. All subjects showed increases in sitting height after training. Respiratory postures and activities showed significant change. The pretest photos showed a marked difference between the "habitual" movements and the "guided" ones, with the "adjusted" movements falling in between. After training, however, the habitual and adjusted movements were indistinguishable, indicating that the subjects had changed their habitual preparatory set. The lack of a control group limits the conclusions that can be drawn from this study. The study does, however, provide interesting data on the effects of inhibition. The authors suggest that by inhibiting the voluntary movement (resisting the impulse to start the movement and allowing the experimenter to start it for them), the subjects were releasing the tonic postural reflexes. These reflexes activate the extensor, or antigravity, muscles. The sit-to-stand motion is thus accomplished reflexively, accounting for the subjective feeling of ease and lightness in Alexander-influenced movement.
Jones and Gilley (1960) used x-ray photography to examine three seated postures: "habitual relaxed," "most erect," and "experimental" (Alexander). When the subjects went from their relaxed to their most erect postures, they lifted the head by shortening the muscles in the back of the neck. In the experimental posture, on the other hand, these muscles remained lengthened and the head still rose. Citing the fact that lengthening of a muscle increases its lifting strength (because it enlists the aid of the stretch reflex), the authors suggest that the experimental posture provides a more efficient postural balance for the head.

Studies by Jones and Hanson (1961) and Jones, Hanson, Miller, and Bossom (1963) did not use the Alexander Technique but established indices that could be used to reliably distinguish good movements from bad ones. Using groups of "well-coordinated," "poorly coordinated" and neurologically abnormal subjects, these studies found statistically significant differences between the groups in various aspects of performing the sit-to-stand movement. Jones and Hanson (1963) re-tested one of these subjects 15 months later and found that his habitual pattern of bodily movement had remained stable over time.

Jones, Gray, Hanson, and Shoop (1961) used a combination of stroboscopic photography and EMG to study the relationship between neck-muscle tension and the individual's subjective postural image. No Alexander intervention was involved. Data were collected as each of the male subjects moved from his "best" posture to his "most comfortable" posture and then to his "greatest sitting (or standing)
height." The study examined the influence of preparatory set by taking continuous EMG readings from the upper trapezius and sternomastoid muscles as subjects prepared to execute the sit-to-stand movement.

The study showed that the sternomastoid muscle actively increased its activity as subjects moved from "most comfortable" to "best" to "greatest sitting height." This muscle proved to be a consistent indicator of postural change (significant at the 0.01 level). The upper trapezius acted in the opposite manner, increasing its activity as the subjects relaxed. The authors suggest that the upper trapezius contracts in response to the forward thrusting of the head which normally occurs in habitual relaxation.

Jones, Hanson, and Gray (1961), in a continuation of the same study (using the same seven subjects), added an Alexander "adjustment" to the three postures under examination. They found that the Alexander influence produced an increase in sitting height over the subject's own "greatest sitting height." At the same time, sternomastoid activity dropped to about the level of the subject's "most comfortable" posture. The authors suggested that the Alexander procedure operates by permitting normal facilitation of antigravity reflexes.

Jones, Hanson, and Gray (1964) argued that the startle reflex is merely a speeded-up version of the gradual process that results in poor posture. Progressive malposture (in aging) is not a passive
surrender to gravity but an active pulling down of the head in response to anxiety and pressure in the modern world.

Jones (1965) summarized his previous work and included a description of his own experience in learning the Alexander Technique. He reviewed selected literature on the functional anatomy of the head and neck and proposed a physiological basis for the results of the Technique. First, Jones noted that neither the upper trapezius or sternocleidomastoid is a primary antigravity muscle of the head and neck (EMG studies prove that both muscles show complete lack of activity during quiet standing or sitting—see EMG Studies, below). This function is carried out by a deeper level of muscles, the head extensors. These run from the base of the skull to various points along the spinal column. The location of the center of gravity of the head causes it to tend to fall forward slightly. Thus, Jones suggested that this subtle forward tilting elicits a continuous, slight stretch on the extensor muscles. This, in turn, triggers the complex stretch/inhibitory reflex patterns discussed earlier. Such a role for the deep extensor muscles would agree with McCouch et al. (1951) who located the receptors for Magnus' tonic neck reflexes in the region of the upper neck.

When, however, the trapezius and sternomastoid muscles (acting together) pull the head down, the stretch is removed from the deep extensor muscles. This inhibits the tonic neck reflex and results in a need for further muscle effort to hold the head up against gravity. Alexander's injunction, "let the head move forward and up," frees the body's postural maintenance system from interference
by keeping the superficial muscles like trapezius and sternomastoid from pulling the head down. Jones suggested that the facilitation of the tonic neck reflex explains the subjective reports of lightness and ease of movement which always accompany Alexander training.

Jones (1976) noted that the trapezius and sternomastoid muscles are among the fastest-reacting in the body. These muscles may habitually act to depress the head, as though stuck in a permanent "startle reflex." Since they react very quickly, reflexive preparatory sets that involve these muscles are hard to change. Jones stressed the need to apply the principle of inhibition:

> In the presence of a stimulus to move, inhibition facilitates lengthening of the spine and adds to the efficiency of the movement. Too quick a response will shorten surface muscles in the neck and prevent lengthening of the spine, which would otherwise take place. (p. 149)

**Further Studies of the Technique.** Dr. Wilfred Barlow was a London physician who sought to bring Alexander's work to the attention of the London medical community. He described the Technique in Pavlovian terms as a form of associative conditioning. Barlow coined the term *postural homeostasis* to describe a balanced resting state to which we should ideally return following each movement. In his view, societal pressures and poor postural models cause us to lose the ability to return to this balanced state. The Alexander Technique provides a way to restore this lost homeostasis. These interesting concepts are discussed in Barlow's book *The Alexander Principle* (1973). The effectiveness of the book is
Unfortunately weakened by very incomplete references as well as a disturbing evangelistic tone.

McCormack (1958) presented evidence that F. M. Alexander was an important (and hitherto neglected) influence in the philosophical development of John Dewey. Dewey's experience as a student of Alexander's confirmed his convictions that individual human experience is the basis of all reality, and that unconscious habit patterns dominate our lives. Dewey wrote introductions to two of Alexander's books (1924, 1932), and devoted 15 pages in Human Nature and Conduct (1922) to describing Alexander's work. F. Jones (1976), in summarizing McCormack's conclusions, states that Dewey's great work Experience and Nature (1929) "cannot be fully understood without knowing what Alexander taught" (p. 103).

The Alexander Technique has been acknowledged and endorsed by other eminent scientists. While such acknowledgements do not constitute actual research, they provide indirect evidence that Alexander's concepts are consistent with existing physiological knowledge. The "Appreciation" written by the biologist George Coghill has already been mentioned. The father of modern neurophysiology, Sir Charles Sherrington, wrote of the Technique in his book The Endeavor of Jean Fernel (1946) and later wrote a letter to Alexander. Nicholas Tinbergen, in accepting the Nobel Prize for Physiology in 1973, used his acceptance speech to describe the Technique and his personal experience as a result of taking Alexander lessons (Tinbergen, 1974).
Studies Related to Musical Performance. F. Jones (1967) presented a paper entitled "The Organization of Awareness" at a conference on "Coordination in Music" at Michigan State University. Drawing from his research with the Alexander Technique, Jones pointed out that our kinesthetic sensations seem unorganized and random when we first begin to give attention to them. After a while, however, one begins to realize that the seemingly disparate elements in this perceptual field are "not chaotic and meaningless but have a central pattern" (page 177).

Jones discussed the nature of preparatory set, proposing that musicians may make mistakes because the preparatory set for action B is being superimposed on action A. We are constantly getting ready for the next thing, and this interferes with the execution of what we are doing now.

Ben Or (1978), a pianist and Alexander teacher, decried the hunched-over, "intense" posture used by many pianists, saying that it is based on the false idea that emotional involvement must be expressed in excess muscle tension and effort. She writes that every aspect of piano playing "can happen in such a way as not to interfere with the state of freedom between the head, neck and torso, so that a balanced coordination of the whole player is undisturbed" (p. 92).

Studies Related to Singing. F. Jones (1972) used sound spectrography to study changes in vocal resonance that occurred when an Alexander teacher (himself) adjusted the head/neck balance of a female singer (within a single experimental session). The
adjustment produced increased richness in upper partials of the tones, and a disappearance of breathing sounds.

The subject reported that she sang more easily, with greater resonance, and with better breath control....Other musicians, who listened to the tape, confirmed the subject's judgment of the difference in the quality of her singing. (p. 214)

The study, using only one subject and no control procedures, was obviously intended only as a pilot investigation.

In her doctoral dissertation, Lewis (1980) discussed the relevance of the Alexander Technique for teachers of singing. She surveyed 70 professional singing teachers to determine their level of familiarity with the Technique. Of the teachers who indicated some knowledge of Alexander (61%), some had learned of it by word of mouth, and others had acquired information regarding the Technique through taking lessons with a teacher. Other responses to the questionnaire showed that 100% of the teachers agreed that physical tensions in particular parts of the body (i.e. the jaw) impair singing performance. But teachers who had experience with Alexander advocated a more integrated approach to achieving balanced tone production. Interestingly, such teachers ranked 'jaw tension' somewhat lower on their list of pedagogical priorities. Lewis suggested that this is due to the fact that jaw tensions often automatically disappear when tensions in the neck and upper back are dealt with. Teachers of singing who are familiar with the Alexander Technique may tend to address common vocal tensions indirectly by improving the head/neck balance, thereby removing interference with the primary control.
Lewis presented teaching suggestions based on Alexander principles. In one activity (also reported in Lewis, 1981), 13 voice class students kept a journal in which they recorded times when they noticed tension in the muscles of the back of the neck. They were asked to describe each occurrence and note (a) whether neck tension interfered with or helped in the performance of a given activity and (b) whether awareness of the neck tension helped in preventing or inhibiting the tension if they chose to do so. Students reported an increasing awareness of tension and a realization that they could, to some degree, consciously inhibit it. Subsequent journal assignments dealt with problems in musical performance. The author has used Lewis' journal concept in his own voice classes with similar results.

Duarte (1981) reported on the significance of preparatory set in singing as related to the Alexander Technique. His physiological information was drawn from F. Jones' research. The author shows how the twin concepts of kinesthetic awareness and inhibition are reflected in the vocal pedagogy literature. In a small experimental study, six vocal students at the New England Conservatory of Music were given four weekly singing lessons based on the Alexander Technique. It is not stated, however, that these lessons were given by an Alexander teacher. The students reported greater ease in singing and a growing awareness of their overall patterns of coordination during (and in preparation for) singing.

Unfortunately, neither Lewis' nor Duarte's studies provide statistically based data on the effectiveness of the Alexander
Technique in vocal training, and the other references in the vocal pedagogy literature are descriptions recommendations based on subjective experience (Calder, 1986; Kelley, 1981; Pilgrim, 1986).

**Progressive Relaxation Therapy**

The relaxation training used in this study was based on Edmund Jacobson’s *Progressive Relaxation* (1938). Jacobson developed a systematic procedure for teaching physical relaxation to patients suffering from psychological disorders related to anxiety. In Jacobson’s original clinical work, the patient was instructed to produce tension in a certain muscle, either by pushing against a resistance or through isometric contraction. The patient was first to notice this tension and then quickly relax the muscle in order to notice the absence of the tension. During subsequent work, the patient was asked to allow the muscle to relax beyond the previously achieved level of relaxation and thereby to develop a awareness of how relaxation itself felt.

Once the patient became comfortable with this process, Jacobson taught him or her how to enter directly into deep relaxation without first tensing the muscles. A complete course of therapy consisted of systematically going through all the major muscle groups in the body using the same procedures. Jacobson noticed that his patients became acutely aware of subliminal tension levels and were often able to head off anxiety responses by consciously relaxing before these responses could take hold.
Electromyography

Muscle fibers contract by means of a chemical exchange involving a depolarization of the cell membrane and a redistribution of ions. These reactions produce an electromagnetic field which is detectable by an electrode placed within the field. Electromyography is the science of detecting and interpreting these electrical signals.

As a motor nerve fiber enters a muscle, it subdivides and connects with not one but a number of individual muscle fibers. This group of fibers, called a motor unit, contracts in an "all or nothing" manner in response to the impulse from its particular motor nerve fiber. Muscles thus increase the force of their contraction by recruiting additional motor units and by increasing the firing rate.

Because each motor unit is made up of a group of muscle fibers, each of which generates its own unique electrical signal, the EMG electrode actually detects a composite reading from many muscle fibers. Basmajian (1985) cited studies indicating that the fibers belonging to many different motor units (as many as 50) may be found interlaced within any small area of a muscle. All of the studies make it clear the voltage detected by the electrode is a highly complex signal.

The EMG literature cautions against assuming that EMG signal and muscle force are always linearly related. A rise in the EMG signal usually corresponds accurately to an equal rise in muscle force during low-level isometric contractions, but at higher levels of contraction the linear relationship breaks down, with EMG activity
increasing faster than muscle force (Basmajian, 1985). Fortunately, preparatory muscle activity produces relatively low-level contractions.

Grossman and Weiner (1966) list factors affecting the reliability of surface electromyography. Several of them, including frequency response characteristics, problems of direct recording, and the need for voltage integration, have been substantially dealt with through improvements in EMG hardware. In a more pertinent point, however, the authors state that it is generally not meaningful to compare individual measurements of MAP [muscle action potentials] obtained from different subjects or from the same subject at different times. For this reason, it is customary to obtain a value for the difference between the resting and stimulus levels of MAP and to compare these differences. However, the studies considered here suggest that the comparison of these differences is open to question since a number of factors are seen to influence the change in MAP for a given change in force of contraction. (p. 81)

This indicates that even though reasonable caution was observed by normalizing the integrated EMG signals (expressing them in relation to resting and maximum levels), the EMG data in this study had to be interpreted cautiously because of the high number of possible influencing factors.

Needle and fine-wire electrodes were not considered for use in this research. Both involve discomfort for the subject and must be implanted by a physician. Basmajian (1985) recommends surface electrodes for several kinds of research, including kinesiological studies of surface muscles and psychophysiological studies. Guidelines found in Basmajian were used to insure proper electrode
placement. These corresponded to standard procedures established by the OSU Biomechanics Laboratory.

**EMG Studies of Muscles Used in this Study**

The large trapezius muscle works variously to rotate, depress, lift or stabilize the scapula and shoulder. Logically, the upper portion of the trapezius (UT) lifts the shoulder (Basmajian, 1985). When the rib cage and shoulders are held firm, the UT pulls the head back and down, as in the startle reflex studied by Jones and Kennedy. Basmajian (1985) reported low-grade postural activity in the muscle during quiet standing. Subjects in a study by Bearn (1961) were able to completely eliminate EMG activity in the muscle when instructed to do so. This shows that the UT is not a primary postural muscle. It is active in deep respiration but is not generally considered an accessory muscle of respiration (Campbell, 1958).

Surface EMG of UT is a straightforward procedure, especially with relatively thin individuals. The muscle lies on the surface of the back of the neck and can provide a relatively clean EMG signal.

The sternocleidomastoid muscle (StM) is a very prominent muscle, easily seen and felt by rotating the head to the side. The muscle has two heads (portions), the sternal and clavicular. The sternal head originates on the anterior surface of the sternum and the clavicular head on the superior surface of the clavicle. The two heads merge as they course upward, laterally and slightly backward, to their insertion in the mastoid process of the temporal bone. StM
flexes the head and draws it forward and acts as an accessory muscle of inspiration (Warwick and Williams, 1973; Zemlin, 1988).

Vitti, Fujiwara, Iida, and Basmajian (1973) found complete inactivity in StM during relaxed sitting and normal breathing, but variable activity in activities involving movement of the head. F. Jones et al. (1961) found that StM was the most consistent indicator of changes in the postural balance of the head.

Surface EMG of StM must take into account the presence of the platysma, a subcutaneous sheet-like muscle which lies superficial to StM. Since platysma extends about halfway up the neck, electrodes must be placed on the upper part of StM (after the two heads join) in order to avoid signal interference. Platysma is active during inspiration, apparently reducing the constricting effect of the skin on the subcutaneous veins of the neck (Basmajian, 1985).

The sternohyoid muscle (StH) acts as a depressor and/or stabilizer of the larynx. Not surprisingly, EMG studies of the muscle have focused on its role in phonation. Sonnininen (1956) suggested that, in trained singers, StH works with the sternothyroid muscle to resist upward movement of the larynx during the singing of high tones. Faaborg-Andersen and Sonnininen (1960), however, using untrained subjects, found that sternothyroid activity decreased as pitch rose, owing to the high larynx position used by untrained singers. When pitch reached maximum levels, however, sternothyroid activity rose dramatically. Since StH works synchronously with sternothyroid, a similar pattern of activity would be expected. This was confirmed by Hirano, Koike, and von Leden (1967), described
below. Faaborg-Anderson and Sonninen also reported significant sternothyroid activity during yawning.

Zenker (1960) investigated the EMG activity of all extrinsic laryngeal muscles in relation to the activity of the cricothyroid. He found that the extrinsic musculature is extremely sensitive to changes in the balanced state of the phonation system, especially changes in respiration, posture, or the position of the jaw and tongue.

Hirano et al. (1967) found no relation between StH activity and the formation of different vowel sounds. The StH EMG levels were greatest for very low and very high pitches and lower for pitches in the middle of the vocal range. StH activity increased with increasing volume regardless of the portion of the range.

Vennard, Hirano, and Fritzell (1971), using three professional singers, found the StH to be less active than some of the other extrinsic muscles during the normal phonation of the three professional singers tested. Activity did increase for higher pitches, however. Yawning produced the highest EMG readings in the StH.

Experimenting with dog larynges, Shin, Hirano, Maeyama, Nozoe, and Ohkubo (1981) found that electrical stimulation of the StH and sternothyroid cause depression of the larynx and changes in its anterior-posterior position. When the StH was removed, the hyoid bone and thyroid cartilage moved upward during electrical stimulation of the sternothyroid.
Wallace (1985) investigated the response of the extrinsic laryngeal musculature to auditory stimulation. When subjects heard high-pitched tones, covert EMG activity appeared in the laryngeal elevators (independent of phonation). Low-pitched tones, on the other hand, stimulated the laryngeal depressors. Thus, the extrinsic muscles, such as StH, appear to be very sensitive to auditory stimulation.

**EMG Studies in Instrumental Performance**

Various researchers have used EMG in order to investigate muscle activity during musical performance on various instruments. Newton (1972) used fine wire electrodes in an exploratory investigation of clarinet embouchure. White and Basmajian (1974) used similar techniques to record the activity of four lip muscles in 18 trumpet players. The later study showed no difference between advanced and beginning trumpet players with regard to the duration of preparatory activity in the embouchure. The advanced players did, however, show more consistency in matching the level of preparatory tension to the actual requirements of the tone.

Using surface EMG, Henderson (1979) investigated the activity of the sternomastoid muscle during trumpet playing. The 18 subjects, who were either expert amateur or professional players, were required to play tones and patterns in different parts of the instrument's range. The study showed that StM tension increased in the upper range and decreased in the lower range. Some players,
however, showed little increase or even a decrease in tension on high tones.

Lammers (1983) used surface EMG to study muscles in the right arm during trombone performance. Among the results was the observation that professional players used less muscle activity than students. Dennis (1984), used EMG to investigate three methods of supporting the string bass. His results indicated no differences in either performance quality or muscle tension.

Holdsworth’s study of covert muscle activity in trumpet players (1974) has been described earlier (see p. 45). Holdsworth argued that preparatory set needed to be regarded as an important frontier of research in music education since "the investigation of covert attention or intention-associated psychomotor processes might serve to elucidate the problems and complexities of psychomotor behavior which occurs during exposure to and observation of musical stimuli" (p. 21). It is interesting that, in his conclusion, Holdsworth attributed some of the ambiguities in his data to the nature of preparatory set itself: "Perhaps the sensory and motor systems should not be expected to operate in the discrete fashion implied by the experimental design used in this study" (p. 162).
CHAPTER III
MATERIALS AND PROCEDURES

Review of Purpose

The primary purpose of this research was to determine the impact of preparatory set in singing and to lay groundwork for further work. The entire experiment was conceived within the understanding that preparatory set is a synergistic psychomotor phenomenon that cannot be measured in its entirety. Thus, the EMG data were considered to be only tentative indicators of preparatory muscle behavior. The study was also intended to add to the research literature on the Alexander Technique by examining the effects of Alexander instruction on habitual preparatory set.

In addition to the three major hypotheses presented in Chapter I (see p. 4), this exploratory study addressed sub-hypotheses related to the following questions. Do individuals show characteristic patterns of preparatory set behavior that are consistent from movement to movement? Can patterns be identified that are common to a number of people? Does training emphasizing kinesthetic awareness produce more preparatory set change than training which does not?

Design of the Study

The study involved 23 subjects, and consisted of identical pretest and posttests separated by 10 days of treatment. The
pretest/posttest consisted of two aspects, audio taping and EMG analysis. All the subjects participated in the audio taping portion, but only 12 subjects were involved in EMG testing (four subjects from each treatment group). This design was necessary because of the time required for the EMG testing and limited access to the equipment. The number of subjects used is not atypical for EMG studies. Though EMG readings must always be interpreted cautiously, the data are comparatively objective and thus reduce the risk of sampling error.

The pretest and posttest audio tapes were analyzed for evidence of improvement in tone quality, while the EMG plots were examined to identify patterns of preparatory muscle activity and to pinpoint significant changes attributable to treatment. Attempts were made to identify correlations between observed changes in preparatory set behavior and improved singing quality.

All experimental sessions were videotaped and the treatment sessions were audiotaped. These permanent records were consulted during various parts of the analysis, particularly to identify EMG fluctuations caused by extraneous movements. Summaries of all treatment sessions are found in Appendices C, D and E.

Pilot Study

The nature of the investigation indicated the need for a pilot study. In addition to enabling the author to become familiar with the equipment and to refine the experimental procedure, it was essential to determine if the muscles to be tested yielded EMG
tracings that could be related to preparatory set behavior, whether there were noticeable differences between subjects, and whether a reduction in preparatory activity would likely register as a reduction of EMG readings. It was also vital to determine how long it would take to process each subject. Most of the time was actually spent in placing the electrodes, setting appropriate EMG gain levels, and establishing baseline values.

The pilot study, involving two subjects, helped determine the muscles to be used and electrode placements. The test indicated that the proposed procedures would work in actual practice and that the EMG readings would provide a useful measure of preparatory muscle activity which could be compared (within limitations) from one subject to another and between pretest and posttest.

Selection of Subjects

Subjects for the study were students between the ages of 18 and 21 who were enrolled in beginning voice class (Music 101.02) at The Ohio State University. The following criteria were used to select from a pool of about 35 applicants:

1. Subjects had had no previous private or group instruction in voice. Choral singing was allowed as long as there was no evidence that the person had received an unusual amount of vocal training as a part of the choral experience.

2. Subjects had had limited or no practical experience with training systems designed to increase mind-body awareness. This included the Alexander Technique and clinical relaxation therapies.

3. Subjects could sing familiar tunes accurately (with acceptable intonation and rhythm) and had a singing range of at least a Perfect 12th.
4. Subjects could match tones played on the piano using the vowel [a] in the low, medium and high portions of their vocal range ranges.

5. Subjects could follow a steady rhythmic beat and begin a given tone on a designated count.

6. Subjects showed no relevant physical abnormalities and certified that they would be engaging in normal activities during the time of the experiment.

7. Preference was given to persons who were relatively slender in the neck area. Surface EMG readings are impeded by subcutaneous fat layers.

During applicant interviews, upper and lower vocal range limits of the prospective subjects were carefully recorded (without warm-up, using the vowel [a]). The top of the range for males was considered to be where the voice broke into falsetto. In addition, each applicant was evaluated for the amount of observable muscle tension. A score of 1 indicated a noticeably relaxed-looking subject, one with little observable tension during phonation. Subjects with average amounts of visible tension (based on the author's experience with untrained voices) received a 2. The ranking of 3 was reserved for subjects who seemed particularly tight. Intermediate scores were also assigned: A rating of 2 1/2 might indicate a subject who displayed average tension most of the time but became very tight on certain pitches.

The most appropriate 24 subjects were selected, 6 males and 18 females. Several exceptions to the criteria had to be allowed because of the limited number of applicants. Three female subjects were 23 years old and one was 29. One of the 23-year-olds had taken some Alexander lessons 5 years previously and had vocal nodules. Because of her Alexander training, she was assigned to the group
receiving progressive relaxation training. One male subject, who had been assigned to the Body Awareness treatment group, dropped out of the study just after it had begun. All subjects were paid for their participation and signed an approved consent form (see Appendix A).

**Forming Matched Groups**

Subjects were assigned to groups in such a way as to make the three groups as comparable as possible. This was deemed particularly important due to the small number of subjects involved. The groups were matched using the following criteria: (a) age; (b) accumulated grade point average; (c) gender--six females and two males in each group; and (d) vocal tension rating.

Table 1 shows the group assignments with age, GPA and vocal tension ranking (VTR) for each subject. See *Treatment* (p. 91) for descriptions of the three groups. **Alexander Group** denotes the group receiving training in the Alexander Technique, **Body Awareness Group** indicates the group being trained in progressive relaxation, and **Vocalization Group** denotes the group that used only standard vocal exercises.

The subjects chosen for EMG testing from each group were selected on the basis of the following:

1. **Size**--the larger the physical structures (larynx, other musculature), the more accurate the electrode placement.

2. **Gender**--three females and one male from each treatment group.
3. Personality assessment—self-assured, relaxed, able to function well in unfamiliar testing situation.

4. Availability during testing times.

Table 1 shows how the mean age, GPA, and VTR of the EMG subjects differed from group means. This variability was considered acceptable given the limitations of the study.

Table 1

<table>
<thead>
<tr>
<th>Alexander Group</th>
<th>Body Awareness Group</th>
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<tr>
<td>Name</td>
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</tr>
<tr>
<td>NN</td>
<td>m</td>
</tr>
<tr>
<td>WR</td>
<td>f</td>
</tr>
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<td>TK*</td>
<td>f</td>
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<tr>
<td>MB</td>
<td>f</td>
</tr>
<tr>
<td>TM</td>
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Vocalization Group

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<th>GPA</th>
<th>VTR</th>
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<td>2.44</td>
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<td>EMG mean: 19.3</td>
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</table>

Audio Pretesting

Each of the 23 subjects performed a song consisting of two familiar phrases (Appendix B). The song had been pre-recorded on cassettes in three different keys, each cassette containing three
repetitions of the song. The first playing included a vocal track in addition to the piano accompaniment; the second and third repetitions presented piano alone. High, medium or low key was chosen on the basis of each subject's vocal audition. The tape was played on a Nakamichi 480 tape deck. Foam cushion earphones (Sennheiser HD420SL) were used in order to maintain normal acoustic feedback for the subjects. After first listening to the sung performance, each subject then practiced the song using the second playing (piano alone). Additional practices were permitted until the subject was comfortable with the task, whereupon the third playing was used to record the performance. Subjects sang into an AKG 1000 microphone from a distance of 10 inches. The performance was recorded on a Pioneer RT-701 reel to reel deck using Ampex 457 recording tape. The procedure permitted the voice to be recorded discretely on one channel with the accompaniment on the other. An RCA camcorder placed 10 feet away at a 45 degree angle to the subjects video-taped all the performances.

**EMG Pretesting**

EMG tests took place in the Biomechanics Laboratory in the Department of Industrial Engineering at OSU. All procedures were under the supervision of a person experienced in the placement of surface electrodes and the operation of the equipment. The arrangement of the various hardware is shown schematically in Figure 1. All pretest and posttest EMG sessions were video-taped.
Figure 1
Schematic Drawing of EMG Testing Set-up
Placement of Electrodes. Electrode sites were selected using the following guidelines:

1. Surface EMG required the use of superficial muscles only (Intervening muscle layers compromise the effectiveness of the readings).

2. Muscles had to be active during preparation for singing as determined by the pilot study or other research.

3. Muscles had to be easily accessible without causing stress or discomfort. This eliminated consideration of the intercostal muscles and other surface muscles of respiration. Differences in hair length also prevented the upper trapezius electrodes from being placed as close to the occiput as was recommended by Alexander Technique teachers.

4. Muscles to be monitored had to be clearly differentiated from others in the area so the electrode would detect only that muscle's electrical activity and not the aggregate activity of a number of muscles. Such a mixed reading would invalidate comparisons made between subjects or between pretest and posttest performances, even when the raw signal was normalized as described below. This restriction made it necessary to avoid using the mylohyoid muscle. The mylohyoid is a very important laryngeal elevator and stabilizer as well as being a superficial muscle. In addition, inexperienced singers generally tend to raise the larynx when singing high pitches. Unfortunately, the proximity of the anterior belly of the digastric and the underlying geniohyoid muscles made clear isolation of mylohyoid impossible with surface electrodes. A measurement of preparatory set activity from the laryngeal elevator group would have been very interesting and is suggested for future projects using fine wire or needle electrodes.

In addition to a single ground electrode, bi-polar electrodes were affixed to the following locations using disposable collars and electrode gel. All sites were free from hair and were cleaned using isopropyl alcohol:

1. Right sternocleidomastoid muscle (StM) above the superior border of the platysma.

2. Left sternohyoid muscle (StH), just lateral to the thyroid prominence. Electrodes were placed very close to midline
since here StH lies just superior to the thyroid cartilage and can be isolated fairly well from the adjacent omohyoid. Each subject was instructed to drop the jaw as if making the vowel [a]. This produced a slight lowering of the larynx. After the location was marked with a skin pen the subject closed his or her mouth and the electrodes were placed.

3. Right upper trapezius muscle (U7). Teachers of the Alexander Technique confirmed that they feel changes in muscle tension in the area right at the base of the skull as they work with students. Electrodes were placed lateral to midline as high up on the subject’s neck as was allowed by the hair length. In some cases subjects allowed their hair to be trimmed a little.

Because laryngeal height varies so greatly from person to person, it is possible that, with sufficient rise in the position of the larynx, the StH electrode may have been influenced by activity from other muscles, especially the cricothyroid muscle which lies just beneath and lateral to the thyroid prominence. There was, however, no reasonable way to determine whether such an influence existed. Electrodes were placed with great care and photographs were taken of all pretest placements in order to duplicate these locations as much as possible in the posttest.

Impedance Levels and Cabling. Electrodes were removed and re-affixed if impedance exceeded commonly acceptable values. Wire leads (one foot long) connected the electrodes to small preamplifiers hanging from a velcro collar around the subject’s neck and shoulder. Shielded cables connected the preamplifiers to the electromyograph. An oscilloscope provided visual inspection of the signals so that waveform anomalies such as 60 cycle interference from lights or nearby extension cords could be identified and eliminated.
Assumptions and Establishment of Baseline Values. EMG readings can be regarded as accurate indicators of muscle force only when the muscle activity is basically static, that is, when the muscle maintains a relatively constant effort throughout exertion rather than increasing in force (W. S. Marraz, personal communication, March 31, 1989). In this study, the baseline tasks as well as the singing tasks were assumed to be static. In addition, the relationship between EMG level and muscle force was assumed to be linear.

It is somewhat unusual to compare one person’s EMG readings to those of another. Any comparisons using only the raw or integrated signals are totally meaningless, since the EMG signal is only a voltage measurement which varies with muscle size, muscle composition, and the amount of effort being used. The only way to make comparisons meaningful is to express an EMG reading as a function of the subject’s maximum and minimum activity for that muscle at the time of testing. Subjects in this study performed the following static exertions to determine the maximum contractile ability of each muscle being monitored:

1. Sternomastoid muscle--The subject rested his or her chin on a padded chin rest adjusted to comfortable standing height. The chin rest was attached to a force sensor connected to a Static Strength Tester (built at the University of Michigan). On signal, the subject rotated the head down (without distorting posture or using back muscles for extra leverage) for four or five seconds. With suitable rest intervals, the activity was repeated until the subject had come within 90% of the previous best effort. Following standard practice in the OSU Biomechanics Lab, this best effort was considered to represent the muscle’s maximum effort. The EMG reading from this effort was stored on a floppy disk (See EMG Data Recording, p. 89, for signal processing specifications).
2. Sternohyoid—Due to its attachment to the hyoid bone, ScH is active in depressing the jaw. The subject stood with his or her chin resting lightly on the chin rest, this time with the jaw slightly open. At the signal, he or she attempted to open the mouth aggressively but without allowing the mouth to open too much or the head to rock back. Subjects were instructed to begin the effort smoothly and steadily increase their exertion during the trial.

3. Upper Trapezius—The subject lay face down parallel to the floor with his or her chest supported by a 32-inch high stool. The back of the head was in contact with the padded force sensor. Subjects attempted to rotate the head back as though trying to look up. They were not allowed to use the arms or lower back for assistance but had to use the neck muscles only.

All subjects were able to supply acceptable maximum contractions within four attempts. Following rest, the subjects were instructed to stand quietly with normal posture for a few seconds, during which time an EMG reading was taken to record the minimum, or resting activity level, of the muscles.

Experimental Trials. After determining that the subject was comfortable and ready to begin, it was explained that further instructions would be presented on tape. A verbatim transcript of these instructions is found in Appendix G. Pitches were played on a Yamaha DX7 synthesizer. The pitches varied from subject to subject but always followed a specific pattern relative to the upper limit of the subject’s vocal range (Pitch #6):

- Pitch #1—Perfect 5th below #6, Loud
- Pitch #2—Major 2nd below #6, Very Loud
- Pitch #3—Perfect 4th below #6, Very Loud
- Pitch #4—Minor 2nd below #6, Loud
- Pitch #5—Minor 6th below #6, Loud
- Pitch #6—Top of reachable range, Very Loud

In the first part of the experiment, the subject was instructed to sing back the played pitch whenever he or she was ready. The
intensity level **loud** was defined as "a fully-energized, well-projected tone," and **very loud** meant "as loudly as possible without distorting the pitch." All tones were sung on the vowel "ah" as in *father*, and the subject was instructed to sustain the tone as long as comfortably possible without reducing intensity. EMG recording began before the pitch was played and ended just after the subject stopped the sung tone (See Figure 2, Sample EMG Plot, p. 91). Throughout the experiment, the subject was allowed to practice each procedure until he or she felt fully ready to begin (See Appendix C).

In the second part of the experiment a rhythmic click track was used to specify the moment for the vocal attack:

```
  x - x - x - x - x - x - x - x
(pitch)                  (sing-------
[--------------------- EMG recording---------------------]
```

The subject was instructed to begin singing exactly on the seventh click. The same pitches and intensity levels were used.

A final part of the experiment required the subject to perform the short song used in the audio recording test (Appendix B). EMG data were collected, but were not analyzed as part of this study.

**EMG Data Recording.** The electromyograph interfaced with an ISAAC 2000 digital-to-analog converter and an IBM-AT computer. Voltages were amplified 52,000 times and sampled at a rate of 50/second using an integration constant of 100 milliseconds. High and low-pass filters produced a band pass range of 80 to 1000 Hertz.
The integrated EMG data for each trial was stored on floppy disk along with the maximum and minimum files.

Following testing, a normalizing program searched the entire disk and located the minimum and maximum values for each muscle. The EMG data for each trial were then combined with these baseline values to print a multicolored plot showing normalized EMG activity across time, that is, a graph showing each muscle’s activity in relation to its maximum and minimum values.

Separate plots were made for each of the experimental trials performed by the 12 subjects during pretesting and posttesting (13 x 12 x 2 = 312). An example is shown in Figure 2. Normalized EMG tracings for each of the three muscles were synchronized on the plot with a microphone input which pinpointed the playing of the pitch as well as the onset of the singing tone. The dependent variables derived from these plots were based on four pieces of information from each muscle’s tracing: onset time of preparatory activity, the moment of peak value, the amount of the peak value, and the onset time of the vocal attack. Detailed information is found in Chapter IV (See p. 110).

Because the maximum muscle voltages were usually far above those generated during the singing tasks, the scale of the ordinal was set at 0.5 of the maximum. This scaling resulted in more readable plots.
SUB: SB1259  CONDITION: PART 1 / EFLAT5 / LOUD

Ch 2: marker
Ch 1: sternocostalis
Ch 2: sternothyroid
Ch 3: trapezius
Ch 4: microphone

normalized EMG signal

0 1 2 3 4 5 6 7 8 9

Time in seconds

Sample EMG plot
**Treatment**

Treatment occurred on the ten consecutive week-days between May 18 and May 29, 1987. Subjects were then in the eighth and ninth weeks of a 10-week spring quarter. Class meeting times were arranged so the author could teach two of the groups as well as attend the Alexander training sessions.

Treatment sessions for all groups were designed to be the same length, though some variability did occur. Mean class session length was 50.5 minutes for the Vocalization group, 46.6 minutes for the Body Awareness group, and 52.8 minutes for the Alexander group.

The following descriptions of treatment are brief. Complete outlines of each group's daily activities can be found in Appendices C, D and E.

**Alexander Training Group.** The Alexander Group was taught by Barbara Conable. Ms. Conable began her study of the Technique in 1962 and has been a certified teacher since 1975. The eight students were seated in a circle on straight chairs. The first session included a description of Alexander's work and an introduction to the kinesthetic sense. Ms. Conable pointed out that most people are highly sensitive to visual and auditory stimuli but are not trained to be kinesthetically perceptive. As we learn to enlarge our field of awareness by attending to kinesthetic information as well, we often discover that our habitual postures and ways of moving are not very comfortable or efficient.

In describing Alexander's primary control, Ms. Conable used simple terms, stressing that the muscles in the back of the neck
should be free and loose. She encouraged the students to become
more aware of tension in the neck area and to release such tension
whenever they noticed it.

Throughout the sessions, Ms. Conable maintained a constant
dialogue with the students as she moved from person to person.
Standing behind or at the side, she would use her hands to help the
student release tension in the back of the neck by allowing the head
to move forward and up. She would then ask for comments on how the
release felt. Other class members, observing her work with a
certain person, would often mention that they could clearly see
changes in the posture or coordination of that person.

A recurring theme during the sessions was Ms. Conable's
insistence that the students avoid narrowing their overall field of
awareness in an attempt to give attention to kinesthetic cues. She
would not allow them to turn their attention inward and thereby
restrict their awareness of the room around them or the other people
in the group. Ms. Conable presented the Alexander Technique as a
means of developing a comprehensive field of awareness in which the
individual can consciously make use of all the sensory modalities
simultaneously.

Though the Alexander students obviously knew that the entire
research study was related to singing, they did not actually sing
very often, and the singing which was done was very informal. The
group used phrases from "Row, Row, Row Your Boat" as well as
portions of "Simple Gifts," a song from the voice class text
(Schmidt, Basics of Singing, Schirmer Books, 1984). They sang at
moderate volume levels (\textit{mezzo forte} or quieter) in the low or middle portions of the vocal range. Ms. Conable asked the students to allow the muscles of the neck to release during the preparation for and singing of each phrase. Comments in class sessions indicated that students could see the relationship between the Alexander principles and their singing, even though class time was not primarily devoted to singing or vocalization. See Appendix C for a detailed outline of class activities.

\textbf{Body Awareness Group.} This group comprised seven subjects. Sessions were based on Edmund Jacobson’s \textit{Progressive Relaxation} (1938), described in Chapter II (p. 69). Though physical relaxation itself was the most visible result of each training session, the real goal of the instruction was to increase kinesthetic awareness so that subjects could choose to inhibit unwanted preparatory tension.

Each training session consisted of several relaxation sequences. Each sequence focused on a certain number of muscles. Seven muscles were used at first, and this number was later reduced to four. Subjects were also taught to enter a deeply relaxed state using a counting technique. During the first three sessions the subjects lay on the floor with their knees bent while supported by pillows. Later, various sitting positions were used. In session 6, subjects began to apply the relaxation principles while standing up. Simple three-note vocalises were first used in session 5, and thereafter every session included a generous amount of singing.
During the early sessions (with the subjects in prone or seated positions), the room lights were dimmed and shades closed. Every effort was made to create an atmosphere conducive to uninterrupted concentration. Subjects were often reminded not to let their minds wander: They were to remain alert and aware even though their eyes were closed. Frequent mention was made of the distinction between progressive relaxation and auto-suggestion: Subjects were simply to notice what was actually occurring, not attempt to think themselves into some kind of altered state.

Subjects reported that deep relaxation was fairly easy to achieve when lying down, but that upright positions (seated and standing) were somewhat confusing. It was difficult to find the balance between relaxation and the maintenance of posture. Some subjects indicated that their singing felt lethargic and tight when they "relaxed," and that it was difficult to reconcile relaxation with the things they had to do to get ready to begin the tone.

This feedback having been anticipated, the students were challenged to discover how to maintain a fully energized posture while simultaneously relaxing everything not necessary to the task of singing. A distinction was drawn between relaxation and collapse.

From session 6 on, songs from the voice class text were used. Building on their ability to quickly enter a relaxed state upon command, subjects were instructed to begin actively relaxing during the second or two just before their vocal attack and to maintain this active relaxation through the beginning of the phrase. They
were asked to "trust the voice" and keep their attention on the relaxation rather than being diverted by the demands of the vocal attack. Sometimes two different attacks were juxtaposed: one with consciously produced tension during the preparation and the next with conscious relaxation as described above. All activities were designed to increase awareness of how the relaxation produced greater tone freedom and better quality. During final sessions, each subject sang a solo for the group. Each was asked to comment on what they felt and how successful they had been in relaxing during the performance. See Appendix D for a detailed description of activities.

Vocalization Group. Each session consisted of the following segments: stretching and relaxation; 10 or 15 minutes of vocalization; a two-minute break; stretching and relaxation; repetition of the vocalises done earlier.

Subjects were told that the purpose of the group was to see if vocalization could be made more effective by inserting a moment of two of relaxation activity between two vocalization periods. This deception allowed almost all of the treatment time to be spent on pure vocalization without producing boredom.

Four or five different vocalise patterns were used each day. These patterns were taken from standard voice class texts. Pedagogical comments typical of college voice class instruction were used, relating to balanced posture, ease and smoothness of inhalation, a feeling of lightness and freedom, balance between bright focus and expansion of pharyngeal space. Beginning in
session 2, subjects sang a song from the voice class text at the end of each session. See Appendix E for a complete outline of activities, including the vocalises used in the class sessions.

**Audio Posttesting**

The audio posttesting procedure was identical to that of the pretest except that subjects needed little or no rehearsal before recording their singing. Equipment and physical conditions were the same. One difference was that posttesting took place during the evening of the last treatment day, whereas the subjects had not sung at all before the pretest. Posttest appointments were arranged so that almost all of the subjects were tested at least two hours after the end of their class session in order to minimize the effect of warm-up.

**EMG Posttesting**

EMG posttesting also paralleled pretest conditions. Electrode placement was faster and was facilitated by reference to photographs taken during the pretest. Subjects were more at ease with the procedure. New maximum and minimum values were obtained so that posttest baselines reflected muscle activity as of the time of the posttesting.

One procedural error was made, which resulted in subject BL being required to sing higher pitches on the posttest than on the pretest. Data from this subject were thus dropped from the study.
It was interesting to note, however, that BL's EMG levels were lower on the posttest in spite of the higher pitches.

**Analysis of Audio Tapes**

The 46 audio tape performances, pretest and posttest, were randomly ordered, edited onto a high quality cassette tape, and played for three expert evaluators during a single session. Two of the evaluators were on the music faculty at Northern Michigan University in Marquette. One was an experienced voice and music education teacher, and the other was a choral director with substantial voice teaching experience. The third judge, not connected with the University, was an active performer/teacher holding a masters degree in vocal performance.

Each evaluator was shown a copy of the song and given a page of directions and score sheets (Appendices B and F). The evaluators were informed that the singers were novice voice students enrolled in a non-major voice class: Scoring was to reflect this knowledge. Each excerpt was evaluated for tone quality using a single Likert-type scale ranging from "poor" to "excellent." The decision to use a single scale rather than separate ones for diction, intonation, freedom, and the like, was based on the author's previous experience as an evaluator. Instead of providing greater precision, multiple scales (in the author's opinion) only serve to increase the subjectivity of an already subjective evaluation.

In order to procure a coefficient of internal judge consistency, the 46 excerpts were presented in random order to the
judges, then presented again a second time in reverse order
(following a short rest break). The judges were not aware that they
were hearing the same excerpts again. This quasi-split-half
procedure also served to double the number of scores used in the
analysis. Each excerpt was separated on the tape by about five
seconds of silence. Judges reported no difficulties in assigning
scores and the evaluation session lasted one hour and twenty
minutes.
CHAPTER IV
PRESENTION AND ANALYSIS OF DATA

Listening Evaluation, Hypothesis 1

A one-way analysis of variance (ANOVA) was run on the listening evaluation data using the General Linear Models (GLM) program in SAS Version 5 (SAS Institute, Cary, N.C., 27511). Table 2 shows the results of this procedure. (It should be stated that two ANOVAs were actually run: one using scores from all three judges and another using scores from the two most reliable judges. See Reliability, below.)

The ANOVA procedure looked for differences among the three groups with respect to each of three dependent variables: pretest, posttest and change (posttest minus pretest). Table 2 shows that the group's mean change scores did not differ significantly from each other at 0.05. Tukey's Studentized Range Test (HSD) confirmed that the groups were not significantly different with respect to change.

One unexpected pretest/posttest change effect did appear, however. When t tests were used simply to compare each group's change score to 0 (no change due to treatment), Table 3 shows a significant negative change for the Vocalization group (Pr > T = .019).
### Table 2

**ANOVA for Audio Analysis of Change Scores with Group as Independent Variable**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>PR&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Judges:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1.98</td>
<td>2</td>
<td>.99</td>
<td>2.99</td>
<td>0.073</td>
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<tr>
<td>Error</td>
<td>6.62</td>
<td>20</td>
<td>.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Judges:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1.80</td>
<td>2</td>
<td>.90</td>
<td>2.74</td>
<td>0.088</td>
</tr>
<tr>
<td>Error</td>
<td>6.57</td>
<td>20</td>
<td>.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3

**t Test on Individual Group Change Scores**

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>SEM</th>
<th>t</th>
<th>PR&gt;t</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCALIZATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Judges:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.52</td>
<td>.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.10</td>
<td>.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>-0.42</td>
<td>.14</td>
<td>-3.03</td>
<td>0.019</td>
</tr>
<tr>
<td>BODY AWARENESS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.05</td>
<td>.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.36</td>
<td>.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.31</td>
<td>.20</td>
<td>1.52</td>
<td>0.180</td>
</tr>
<tr>
<td>ALEXANDER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.29</td>
<td>.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.17</td>
<td>.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>-0.12</td>
<td>.26</td>
<td>-0.48</td>
<td>0.647</td>
</tr>
<tr>
<td>VOCALIZATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Judges:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.72</td>
<td>.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.41</td>
<td>.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>-0.31</td>
<td>.12</td>
<td>-2.55</td>
<td>0.038</td>
</tr>
<tr>
<td>BODY AWARENESS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.21</td>
<td>.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.57</td>
<td>.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.36</td>
<td>.27</td>
<td>1.34</td>
<td>0.229</td>
</tr>
<tr>
<td>ALEXANDER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.47</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>4.31</td>
<td>.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>-0.16</td>
<td>.22</td>
<td>-0.71</td>
<td>0.503</td>
</tr>
</tbody>
</table>
Both the smaller negative change in the Alexander group and the gain in the Body Awareness group were insignificant. The discrepancy (no significance when the groups were compared to each other but significance when they were looked at separately) is explained by two factors.

The first factor is the tremendous difference in variance between the Vocalization group and the other two. With all three judges' scores included, the Vocalization group's variance (the square of the standard error) was less than half that of the Body Awareness group and less than a third of Alexander group. With only two judges, the ratios fell to 20% and 29%, respectively. With the Vocalization group set apart in this way with respect to variability, the t test indicated a significant treatment effect (albeit a negative one) while the ANOVA showed no significant change (i.e. no group did better than any other group).

Second, examination of the pretest and posttest mean scores for each group (Table 3) aroused suspicion that the groups were not equal to start with: The Vocalization group scored higher on the pretest than the other groups. This may have affected the gain (change) scores in some way. Even though the ANOVA showed no significant group difference in pretest scores [\(F(2,20) = 0.66\) (three judges), 0.60 (two judges)], a post hoc ANCOVA was run to compensate for any discrepancies between the groups. Group and pretest were assigned as the covariants with posttest as the dependent variable. The results [\(F(3,19) = 2.11\)] confirmed the
ANOVA: Group posttest scores were not significantly different from each other.

Reliability of Judges. Table 4 shows interjudge reliability coefficients (computed using the covariance matrix found in SPSS-X, version 2.2). The coefficients, which show how well each adjudicator's scores agreed with those of the others, range from .7687 on the original presentations of the pretest tapes to .5536 on the restatements of the posttest tapes. Keep in mind that the pretest and posttest tapes (1-46) were presented in random order followed by a counter-balanced restatement (46-1). The coefficients for the original presentations (.7687 and .6920) are higher than those for the restatements (.5928 and .5536), indicating a possible fatigue effect.

Table 4

<table>
<thead>
<tr>
<th>Interjudge Reliability Coefficients</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Pretest Original</td>
<td>.7687</td>
</tr>
<tr>
<td>Pretest Restatements</td>
<td>.5928</td>
</tr>
<tr>
<td>Posttest Original</td>
<td>.6920</td>
</tr>
<tr>
<td>Posttest Restatements</td>
<td>.5536</td>
</tr>
</tbody>
</table>

These interjudge reliability coefficients reflect the fact that every voice teacher evaluates tone quality from within a specific pedagogical framework and tone aesthetic. It is not surprising that the judges did not assign the same scores to each excerpt. Some variability here does not affect the dependability of the data as long as each judge was consistent within his or her own judging framework.
Table 5

**Individual Judge Reliability**

<table>
<thead>
<tr>
<th>Judge</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.6961</td>
<td>.5985</td>
</tr>
<tr>
<td>2</td>
<td>.8163</td>
<td>.9138</td>
</tr>
<tr>
<td>3</td>
<td>.5079</td>
<td>.4563</td>
</tr>
</tbody>
</table>

The level of this consistency is shown in Table 5, in which coefficients show the level of correlation between each judge's pretest and posttest scores (combining original and restatement presentations). The high consistency level of Judge 2 attests to basic soundness of the evaluation procedure used in the study. Judge 1's coefficients, while lower, were deemed adequate, but it was determined that Judge 3's coefficients indicated the need to repeat the ANOVA using only the scores of the most consistent two judges. This explains why data from two separate ANOVAs are presented in Tables 2 and 3.

**Discussion.** It was clear from the initiation of this study that the prospect of finding significant treatment differences was small, given the limited available subject population, group size, and length of treatment period. This indeed proved to be the case, but a discussion of the gain scores of the three groups relative to Hypothesis 1 will be valuable as a guide to future research on preparatory set in singing. Hypothesis #1 is restated below.

Though all three treatment groups will show some improvement in singing quality following treatment, the groups receiving special training in kinesthetic awareness and/or relaxation (Alexander and Body Awareness) will improve more than the group that merely vocalized. The Alexander group will make the most improvement.
The hypothesis must obviously be rejected: ANOVA and ANCOVA revealed no significant training effect differences among the groups. A number of interesting questions remain, however.

The t-test comparing group change score to 0 revealed a borderline negative change for the Vocalization group. Did 10 days of treatment using common vocal exercises make a group of beginning singers worse instead of better? Since the number of subjects available precluded the use of a true control group (one receiving no intervention at all) and a review of the treatment sessions for the Vocalization group revealed nothing which would account for such a result, the change (since it was a borderline effect) was probably the result of testing error. One is still left, however, with the indication that a regimen of standard vocal exercises alone (apart from musical performance) will not produce better singers.

Why didn't the Alexander Technique sessions make any difference in tone quality? The length of the training period was undoubtedly the major factor. Ten training sessions were not enough to produce a perceivable change in the subjects' singing. The subject selection process and certain characteristics of the training sessions themselves may have contributed to the result as well.

During the planning stage of the study, Ms. Conable commented on the fact that the subjects in her class were going to be different from her ordinary students in several ways. Students of the Alexander Technique are generally highly motivated (lessons are expensive), begin study with some knowledge of the Technique, and often possess some already-developed skill to which they want to
apply their study. The subjects in this research, while motivated by the promised stipend if not by a general curiosity, had never heard of the Alexander Technique, were novice singers, and were assigned to groups using matching criteria. In addition, the normal Alexander class comes together for the first time sharing at least one other thing in common: a certain level of trust in the teacher. Ms. Conable's students had no idea what they were about to encounter and nothing but the author's assurance that the training was legitimate.

As a result, the Alexander subjects undoubtedly spent the first class periods learning to trust the teacher as well as being introduced to entirely unfamiliar concepts. While Ms. Conable's discussion material was the same as for any of her introductory classes—a description of Alexander's personal experience, a simple description of the function of the "primary control" and an introduction to the kinesthetic sense—her teaching was undoubtedly influenced to some extent by her knowledge that these students had not come to her with the intent of learning about the Technique but were instead fulfilling a commitment to a research study. This should not be taken to imply that the students were bored. On the contrary, all subjects participated enthusiastically and felt they had made progress following training.

The implication for future research in this area is clear. Any controlled study that uses Alexander training as one of a number of treatments must reckon with the fact that both the subjects and the
training itself are going to be nonypical due to the nature of the subject selection process.

A second factor was the small amount of singing done during the Alexander sessions as well as the nature of that singing. Though Ms. Conable often referred to the relationship between Alexander principles and singing (especially in regard to breathing freedom), the subjects did not sing very much. All singing was done in unison and consisted of simple phrases from familiar songs. No high pitched or forte singing (such as was required on the audio testing song) was attempted.

One might well surmise that if the Alexander training had been applied more directly to singing, the subjects would have had some improvement in tone quality. More singing could have been done throughout the training period. Subjects might have been asked to sing louder using higher pitches as Ms. Conable used her hands to help them overcome habitual tensions. On the surface it seems that the sessions could easily have been made much more effective by applying the Alexander principles to higher pitches, increased loudness, and more intense musical expressiveness.

Such changes, however, would very likely have compromised some of Alexander’s most basic concepts, especially considering the short training period involved. As discussed in Chapter I, Alexander asserted that habitual patterns of coordination are extremely resistant to fundamental change. Bad habits tenaciously reassert themselves in spite of our best intentions, and the disoriented kinesthetic sense prevents us from even noticing what we are really
doing. Alexander training provides a way out of this condition, but this re-education does not happen overnight. The more strenuous the task (in the student's conception), the more certain it is that old habits will take over. New, more efficient habits take time to develop.

The hypothesis had predicted that the Alexander group would make more improvement than the Body Awareness group. Though this prediction was clearly unfulfilled from a statistical standpoint, the difference in mean gain scores between the two groups prompts the informal suggestion that the relaxation training used in the Body Awareness group may have been a little more effective than the Alexander training. Or at the very least, the relaxation training was just as effective. Why might this be the case?

While the subjects in the Body Awareness group had to become accustomed to the specific procedures used in the sessions, relaxation itself was a familiar concept. The members of the Alexander group, on the other hand, were confronted with new ideas as well as a somewhat strange, hands-on mode of instruction.

In addition, the progressive relaxation activities done in the Body Awareness group involved all of the subjects all of the time, while Ms. Conable moved around the room assisting each person individually. The other students were encouraged to observe and ask questions, but they were not continuously being assisted by the teacher. Looked at from one standpoint, then, the Body Awareness subjects received much more training time than the Alexander subjects. On the other hand, the subjects in the Body Awareness
group may have been thinking about other things during the
progressive relaxation sequences. There was no way to measure their
level of attentiveness or understanding. What Alexander students
lose in quantity of training may be made up in the quality of
interaction that can be achieved through the actual touch of the
skilled teacher.

A third difference between the two groups was the amount of time
spent singing. As has already been seen, the Alexander group sang
very little. The Body Awareness group began applying progressive
relaxation skills to simple three note vocal patterns in the fifth
session and used song phrases and short vocal exercises as part of
each session thereafter. Each subject sang a familiar solo during
one of the last two meetings. Emphasis was placed on achieving a
relaxed state before the vocal attack and maintaining this level of
relaxation throughout the attack and ensuing phrase.

Given the familiarity of relaxation as a concept, the continuous
relaxation activity during each session, and the large amount of
time spent in singing and vocalization, it actually seems very
surprising that the Body Awareness group did not produce better
improvement. This may be related to some degree to the nature of
relaxation training. It is possible that relaxation activities
performed in prone or supported seated position (i.e. no postural
component to contend with), actually reinforce a serious
misconception, namely that to relax is to collapse. Jacobson
himself was careful to distinguish passive relaxation from training
in differential relaxation, in which the patient learned to relax unnecessary tension while maintaining normal activity.

Though the author tried in his teaching to make clear the difference between relaxation and general postural collapse, this distinction was apparently very difficult to grasp. As long as they were lying down with pillows supporting their limbs, the subjects indicated no difficulty in relaxing, but when they were later asked to relax muscle groups while sitting or standing, they sometimes reported that they felt uncomfortable or "stuck." Some mentioned that "relaxed" singing felt tight and sounded anemic or dull. All of the above reinforce the portions of Chapter I that discuss the dangers of using relaxation to teach motor skills.

EMG Analysis, Hypothesis 2

EMG data from 11 subjects were analyzed involving the following independent variables: pitch (high, low), loudness (loud, very loud), time (pretest, posttest) muscle (StM, StH, UT), and group (Vocalization, Body Awareness, Alexander).

176 EMG plots (11 subjects, eight pretest trials, eight posttest trials) and their corresponding floppy disk files were examined to obtain exact values for each of the following.

**EMG Peak**--maximum EMG value reached between EMG onset and one second following the vocal attack. The normalized value was derived from the formula:

\[
\text{Maximum} - \text{Baseline Minimum} / \text{Baseline Maximum}
\]

**Onset Time**--starting time of EMG activity judged to be preparatory for the vocal attack.

**Peak Time**--moment of EMG Peak.
**Attack Time**—moment of vocal attack.

This information was used to derive values from each EMG plot for 18 dependent variables:

**EMG Peak** (same as above)
1. StM
2. StH
3. UT

**Onset Lead** (Attack Time minus Onset Time)
4. StM
5. StH
6. UT

**Peak Lead** (Attack Time minus Peak Time)
7. StM
8. StH
9. UT

**Onset Lag** (subtract Onset Times of two muscles)
10. StM - StH
11. StM - UT
12. StH - UT

**Peak Lag** (subtract Peak Times of two muscles)
13. StM - StH
14. StM - UT
15. StH - UT

**Onset Slope** [EMG Peak/(Peak Time minus Onset Time)]
16. StM
17. StH
18. UT

The MANOVA (Multiple Analysis of Variance) command option of SAS GLM was used to identify significant differences related to the class variables Time, Group, and Group-Time Interaction. A separate MANOVA was carried out on each muscle (with all 18 dependent variables examined simultaneously) and on each of the six dependent variable categories (Peak, Onset Lead, Peak Lead, Onset Lag, Onset Lead, and Slope). The MANOVA provided F values for Wilk's Criterion, Pillai's Trace, and the Hotelling-Lawley Trace. The significant results are presented in Table 6.
Table 6.

**Significant Results of MANOVA on EMG data (All values below 0.10 included. HL = Hotelling-Lawley Trace)**

<table>
<thead>
<tr>
<th></th>
<th>Wilkes</th>
<th>Pillai's</th>
<th>H-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>StM--Time: $F(4, 159)$</td>
<td>.009</td>
<td>.009</td>
<td>.009</td>
</tr>
<tr>
<td>StH--Time: $F(4, 159)$</td>
<td>.061</td>
<td>.061</td>
<td>.061</td>
</tr>
<tr>
<td>Slopes--Group-Time Interaction: $F(6, 304)$</td>
<td>.021</td>
<td>.023</td>
<td>.019</td>
</tr>
<tr>
<td>Peaks--Time: $F(3, 152)$</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>(same)--Group-Time Interaction: $F(6, 304)$</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>StM Peak, Slope, &amp; Peak Lead--Group: $F(6, 12)$</td>
<td>.049</td>
<td>.099</td>
<td>.035</td>
</tr>
<tr>
<td>(same)--Time: $F(3, 160)$</td>
<td>.006</td>
<td>.006</td>
<td>.006</td>
</tr>
<tr>
<td>UT Peak, Slope, &amp; Peak Lag--Time: $F(3, 152)$</td>
<td>.012</td>
<td>.012</td>
<td>.012</td>
</tr>
<tr>
<td>(same)--Group-Time Interaction: $F(6, 304)$</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Since MANOVA uncovered some significant effects, an ANOVA was conducted on each of the 18 dependent variables in relation to the following class variables: Group, Time, Loudness, Pitch and Group-Time Interaction. All five of these independent variables were compared simultaneously with each EMG variable. $F$ values were computed using standard error terms except in the case of the variable Group, for which a special error term (Subject nested within Group) was used. This nested variable, which revealed whether the subjects within each group were significantly different from each other, produced probabilities of .0001 in almost ever
case. This provides evidence to support the supposition that preparatory muscle behavior is highly individualistic.

The ANOVA data are summarized in Table 7, a listing of all levels of significance below 0.07. The fact that the variable Group showed no significant differences indicates that the three treatment groups were comparable, since "Group" was defined irrespective of training effect (i.e., pretest and posttest scores were combined for each group).

Table 7

Summary of Significant Results (p < 0.05) of ANOVA on EMG Data

<table>
<thead>
<tr>
<th>EMG Variable</th>
<th>Time</th>
<th>Pitch</th>
<th>Group/Time Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak StM</td>
<td>.005</td>
<td>.006</td>
<td>.031</td>
</tr>
<tr>
<td>Peak StH</td>
<td>.044</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Peak UT</td>
<td>.001</td>
<td></td>
<td>.001</td>
</tr>
<tr>
<td>Onset Lead StM</td>
<td>.050</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset Lead StH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset Lead UT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Lead StM</td>
<td>.024</td>
<td>.008</td>
<td>.006</td>
</tr>
<tr>
<td>Peak Lead StH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Lead UT</td>
<td></td>
<td>.038</td>
<td></td>
</tr>
<tr>
<td>Onset Lag:StM-StH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset Lag:StM-UT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset Lag:StH-UT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Lag:StM-StH</td>
<td></td>
<td>.005</td>
<td>.056</td>
</tr>
<tr>
<td>Peak Lag:StM-UT</td>
<td></td>
<td>.028</td>
<td>.036</td>
</tr>
<tr>
<td>Peak Lag:StH-UT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope StM</td>
<td>.070</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope StH</td>
<td></td>
<td>.024</td>
<td></td>
</tr>
<tr>
<td>Slope UT</td>
<td>.339 (.075)**</td>
<td></td>
<td>.003</td>
</tr>
</tbody>
</table>

** Note: SAS GLM performed a post hoc LSD test and determined that UT Slope was significantly different in relation to Time. 0.339 was the p > 0.05 when a type III sum of squares was used in the ANOVA; 0.075 was the p > 0.05 when a type I sum of squares was used.
The data in Table 7 for Time and Pitch effects are presented in graphic form in Figure 3 and Figure 4. Summarizing the Time effects, the histograms show that mean EMG peak values were lower on the posttest for StM and UT, and higher for StH. StM Onset Lead decreased on the posttest as did the StM Peak Lead. Slopes for both StM and UT decreased, indicating a more gradual loading of the muscles on the posttest. The Pitch graphs reveal that medium-range pitches produced lower peak values than high ones for StM and StH.
Figure 3
Mean Values of Significant EMG Effects for Time
(Note: ordinals of histograms not to scale; see specific value above each bar)
1 = medium pitch, 2 = high pitch

Figure 4
Mean Values of Significant EMG Effects for Pitch
(Note: Ordinals of histograms not to scale; see specific value above each bar)
Peak Lag times between StM and StH and between StH and UT both decreased on higher pitches, that is, the muscles tended to reach peak values more nearly at the same time on higher pitches. Peak Lead times for both StM and UT decreased on the higher pitches, and the StH Slope became significantly steeper on higher pitches, indicating more sudden muscle loading.

**Discussion.**

Hypothesis #2 is restated below.

There will be correlations between improvement in singing quality and observable changes in preparatory muscle behavior as measured by EMG.

The hypothesis could not be accepted or rejected because of the results of the listening evaluation (no significant difference in singing quality). It had been hoped that the pattern of change among the group gain scores on the listening evaluation would be duplicated on some of the EMG measures. Such similarities would have established at least a tentative link between observed changes in preparatory muscle behavior and improvement in singing performance. Tone quality did not improve significantly, however, and this made such a correlation analysis impossible.

The fact that significant EMG changes did occur without causing a change in perceived tone quality is in fact an interesting finding of this study. For all three muscles tested, the 11 subjects as a group used significantly less muscle effort on the posttest (as judged by Peak values). Inasmuch as tone quality was unaffected, should one then suspect that singing performance is not influenced by the preparatory set of postural muscles in the head and neck.
area? To such a vague form of the question the answer is clearly no, but the data reveal something about the nature of preparatory muscle behavior. In these subjects, significant changes in muscle tension occurred in one part of the system which had no audible effect on the output. It is apparent that there is a tremendous amount of flexibility built into the neuromuscular control systems for singing. Current knowledge suggests that subcortical coordinative programs may compensate for reductions in muscle activity by adding tension to some other part of the system. Such an adjustment may be made in order to satisfy the specifications of the conscious executive command, in this case the singer’s preconceived tone concept. If this is the case, it would support the idea that mental conceptualization of the tone is an extremely important factor in singing and that it is closely related to preparatory set.

Having thus looked at the relationship of preparatory set and tone quality, the EMG data can now be examined independently. The effects of different loudnesses and pitches will by followed by a discussion of group training effects.

Loudness. The directive to sing "very loud" as opposed to "loud" did produce audibly different loudness levels in most cases, but none of the EMG measures were significantly affected. Presumably, once the dynamic level reaches forte, greater loudness is dependent on laryngeal and airflow changes which do not affect the surrounding postural muscles. This study used high dynamic levels because pilot testing had indicated that mezzo forte singing
produced ambiguous levels of EMG activity. It is reasonable to predict that subsequent studies using needle or wire electrodes might discover significant changes in preparatory set related to loudness, especially when lower dynamic levels are used.

**Pitch.** As Table 7 (p. 113) and Figure 4 (p. 116) show, pitch does have a significant influence on preparatory muscle behavior. Both the StM and StH muscles had significantly higher Peak values on the high-pitched trials. Since the "low" pitches were actually from the upper middle part of the vocal range (a perfect fifth and perfect fourth from the highest vocalized note) and the high pitches only about a fourth higher, the large changes (PR > t = .0001 in each case) show that anticipatory muscle tension increases quickly near the top of the vocal range. Since it seems logical to assume that these novice singers would use less efficient preparatory sets on high pitches, the data provide some basis for the hypothesis that Peak EMG values will rise as overall preparatory behavior deteriorates.

No significant pitch effect was found for the Peak of the UT, an interesting result in contrast to the strong effects present for the other two muscles. One simple explanation, that UT is too far from the larynx to really be involved, is discounted by the fact that the muscle did show significant pitch effects in two other EMG variables, Peak Lead and Peak Lag. Changes did occur in response to pitch, but an increase in preparatory tension was not one of them.

With two of the muscles, StM and UT, the Peak Lead decreased significantly in response to higher pitch. The StM Peak Lead
decreased .14 seconds (from .176 to .031) and UT showed a decrease of .12 seconds (from .265 to .153). This means that when the pitch was higher, subjects tended to reach their maximum preparatory tension level nearer the moment of the vocal attack. This might be attributable to a change in the rate of muscle fiber recruitment. In addition, a coactivation effect might be indicated by fact that the amount of the change was almost identical for both muscles.

The Onset Lag and Peak Lag variables were designed to reveal changes in the sequence of preparatory behavior between different pairings of the muscles. The Onset Lag variable did not prove responsive to change in pitch, but the Peak Lag showed two significant changes, both of which are related to the Peak Lead changes mentioned above. StM reached its EMG peak an average of .195 seconds before StH for the low pitches; on high pitches the mean lag time was virtually eliminated (.007 seconds). UT peaked .264 seconds before StH for low pitches, but the lag decreased to .106 seconds on the high pitches. The findings indicate that the muscles involved with the postural balance of the head (StM and UT) reach their peak earlier than StH, which has an indirect laryngeal support function. This result agrees with the findings of Belenkij et al. (1967), Marsden et. al (1977), and Bouisset and Zattara (1981), all of whom identified anticipatory postural movements that preceded voluntary movements. The fact that Peak Lag decreased on high notes may mean that muscles tend to reach their maximum preparatory activity more simultaneously when attacking higher tones.
The changes in Peak Lead and Peak Lag were interestingly not accompanied by changes in the Onset Lead or Onset Lag variables. Each muscle began its activity around the same time (relative to the attack) regardless of pitch, but StM and UT took longer to reach their peaks. Further research is needed to determine the reliability and usefulness of lead and lag times in describing muscular interaction during preparatory set.

The final EMG variable responsive to pitch change was the StH Slope, which rose significantly on the high pitches. As described earlier, the Slope value was intended to provide a rough measure of the rate of rise of muscle activity during preparatory set. The Slope change noted here for StH is a simple result of a higher Peak value combined with no changes in Onset Lead or Peak Lead. On the other hand, StM and UT, though both posting greater Peak values for the higher pitches, also had shorter Peak Lead times, thus producing overall Slopes values which were not significantly different. A correlation between higher pitches and steeper onset slopes might indicate that muscles increase their activity more rapidly during less efficient preparatory sets. It is reasonable to surmise that singers learn to somehow adjust the loading speed of the musculature in order to produce the most efficient attack.

Summarizing the discussion of pitch effects, several of the EMG variables were responsive to pitch change for at least one muscle: Peak, Peak Lead, Peak Lag and Slope. The muscles did not respond uniformly: No variable elicited a change from all three muscles. This indicates that preparatory muscle activity is a complex
phenomenon. Future studies will have to delay issuing general statements until interactive relationships of the muscles are better understood.

Based upon the conjecture that singers tend to use less efficient preparatory sets for higher pitches, the data suggest correlations between improved preparatory set and (a) reduction in EMG Peak value, (b) reduction in Slope, (c) increase in Peak Lead time, and (d) increase in Peak Lag time.

The muscles involved in maintaining head posture (StM and UT) both peaked before the extrinsic laryngeal muscle (StH) and changed their peak time by almost the same amount. This may signify a preparatory postural balancing of the head which precedes actual laryngeal adjustment. The lag time between these events was less for high pitches.

Group/Time Interactions. The column marked Time in Table 7 (p. 113) shows that several of the EMG variables changed significantly on the posttest using the overall means of the 11 EMG subjects. Because Time as a main effect did not differentiate by treatment group, the changes say nothing about training effect unless one examines the contribution of each individual group (a second main effect) to the overall change. This, of course, is the essential question of the study: Did the three treatments differ in their influence on preparatory set?

Figure 5 illustrates the interaction effects from Table 7 (p. 113) using double classification plots. The Peak Lead StM is included even though its significance level was .056.
Figure 5
Group/Time Interactions
(Horizontal grouping by EMG variable, vertical by muscle)
The criss-crossing occurring on each of the interaction plots reveals that the three treatments did not produce identical effects on the muscles. In each case one of the lines moves in the opposite direction of the other two. There is no pattern among the three treatments that is consistent across the seven variables. In addition, no single treatment caused all or a majority of the opposing changes.

It can be noted, however, that in all six of the interactions that were significant at or beyond the 0.05 level, the Body Awareness and Vocalization lines move in opposite directions. On the audio test, the difference in gain scores between these two groups was the greatest. Tukeys' Studentized Range (HSD) Test showed that the difference was very nearly significant at .05 when all three judge's scores were used (minimum required difference of .745, actual difference of .726). Thus, the treatments producing the greatest audio test differences also produced opposing EMG changes on every significant Group/Time interaction. While this observation says nothing conclusive, it adds to the suspicion that correlations do indeed exist between improved singing performance and specific changes in preparatory muscle activity.

As noted already, the short treatment period probably prevented the Alexander Technique training from registering a significant effect on tone quality. The EMG interactions suggest that the training did have one unique effect, however. The Alexander group contrasts sharply with the other groups in the Peak and Slope of the UT muscle. Especially with Slope, where they posted over a 50%
reduction, the Alexander subjects obviously acquired and retained a much greater ability to influence the anticipatory behavior of this neck muscle. This indicates that the Alexander training had begun to register an effect on muscle behavior, even though no perceived change in singing quality occurred.

The graph showing the Peak Lag between StM and StH requires some explanation, since there at first glance seems to have been a dramatic difference between the Alexander training group and the other two groups. The difference, however, is not attributable to treatment. The positive values for the Alexander subjects simply show that StM reached its peak level before StH muscle. This pattern was reversed in the other two groups for some reason. Following training, both groups showed an increase in their respective patterns.

The Influence of Timing, Hypothesis 3

The hypothesis was based on the prediction that singers’ preparatory behavior would be more organized and consistent from trial to trial when they were relieved of the responsibility of choosing the moment of attack. This was tested by adding a rhythmic click track to the trials in Part II. Pitches, loudness levels and pitch sequence were the same for both Parts.

Because the hypothesis was not concerned with treatment effect, only data from the pretest were used in the analysis, four trials from Part I and four from Part II. For each of the 18 EMG measures, the standard deviation of the four trials on each Part was computed
for each of the 11 subjects. These 11 standard deviation values for Part I were then compared with those of Part II using the t test for difference between dependent samples. The formula
\[ t = \frac{\overline{D}}{S_D / \sqrt{N}} \]
was used, in which D represents the mean of the 11 subjects' difference scores (the difference score being each subject's standard deviation from Part II subtracted from the value for Part I), and \( S_D \) represents the standard deviation of these difference scores. This test was applied to each of the EMG measures to identify significant changes in the variability of the muscle behavior between the two parts.

Table 8 summarizes the results. The tests were considered to be two-tailed in spite of the apparent directionality of the hypothesis (see restated null-hypothesis, below). Nevertheless, the table also includes two EMG measures which passed the one-tailed t test but did not reach significance at .025.

The StH and UT Peak Leads were significantly more consistent (showing less variability) on Part II, with the Peak Lag between these muscles also becoming more uniform as a direct result. On the other hand, four of the EMG measures posted an opposite change (the rhythmic attack produced less consistency), and two of these four were not significant at .025, the level required for a two-tailed test. The remaining 11 EMG measures showed no significant change.
Table 8

t tests for Differences Between Dependent Samples:
Mean Variability of Standard Deviations Between
Part I and Part II.

<table>
<thead>
<tr>
<th>EMG Variable</th>
<th>t</th>
<th>signif. at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak: Sternohyoid</td>
<td>-2.668</td>
<td>.025</td>
</tr>
<tr>
<td>Onset Lag: StH-UT</td>
<td>-1.862</td>
<td>.05</td>
</tr>
<tr>
<td>Peak Lag: StH-UT</td>
<td>2.719</td>
<td>.025</td>
</tr>
<tr>
<td>Peak Lead: Sternohyoid</td>
<td>3.568</td>
<td>.005</td>
</tr>
<tr>
<td>Peak Lead: Upper Trapezius</td>
<td>2.650</td>
<td>.025</td>
</tr>
<tr>
<td>Slope: Sternomastoid</td>
<td>-1.832</td>
<td>.05</td>
</tr>
<tr>
<td>Slope: Sternohyoid</td>
<td>-2.330</td>
<td>.025</td>
</tr>
</tbody>
</table>

While the dependent samples t test shows change in performance variability based on the mean of the entire sample, it does not indicate whether individual subjects responded differently from each other to the rhythmic condition of Part II. If, for instance, Subject A had standard deviations of .67 on Part I and .75 on Part II, while Subject B had deviations of 1.18 on Part I and .48 on Part II, it would indicate that the rhythmic beat of Part II had opposite effects on the two subjects. Subject A would have become less consistent while Subject B would have become more consistent. Such a finding, however, would not surface through the use of a test in which t was calculated using the mean and standard deviation of the difference scores.

A comparison of the variances (the square of the standard deviation) of Part I and Part II provides an indicator of whether subjects responded to the rhythmic track uniformly or tended to respond in opposite directions. Table 9 shows that there were often tremendous increases in this variance under the rhythmic condition. Eight of the EMG measures showed increases averaging 405% with a low
of 246%. Seven of the measures remained steady and only three decreased.

Table 9

Comparison of the Variance Between Part I and Part II

<table>
<thead>
<tr>
<th>EMG Measure</th>
<th>Variance Part I</th>
<th>Variance Part II</th>
<th>Direction of Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG Peak STH</td>
<td>9.746</td>
<td>30.678</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StH</td>
<td>1.476</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>UT</td>
<td>3.760</td>
<td>increase</td>
</tr>
<tr>
<td>Ons. Lag STH</td>
<td>.044</td>
<td>.190</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StM-StH</td>
<td>.043</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>StH-UT</td>
<td>.029</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StH-UT</td>
<td>.038</td>
<td>decrease</td>
</tr>
<tr>
<td>Pk. Lag STH</td>
<td>.077</td>
<td>.016</td>
<td>decrease</td>
</tr>
<tr>
<td></td>
<td>StM-UT</td>
<td>.018</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StM-UT</td>
<td>.047</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>StH-UT</td>
<td>.055</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>StH-UT</td>
<td>.037</td>
<td>decrease</td>
</tr>
<tr>
<td>On. Lead STH</td>
<td>.026</td>
<td>.064</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StH</td>
<td>.037</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>UT</td>
<td>.048</td>
<td>steady</td>
</tr>
<tr>
<td>Pk. Lead STH</td>
<td>.049</td>
<td>.020</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>StH</td>
<td>.063</td>
<td>decrease</td>
</tr>
<tr>
<td></td>
<td>UT</td>
<td>.037</td>
<td>steady</td>
</tr>
<tr>
<td>Slope STH</td>
<td>6.600</td>
<td>28.459</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>StH</td>
<td>151.718</td>
<td>steady</td>
</tr>
<tr>
<td></td>
<td>UT</td>
<td>20.801</td>
<td>steady</td>
</tr>
</tbody>
</table>

Discussion

Hypothesis #3 is restated below.

When subjects are required to attack the pitch on a certain beat, the preparatory response will be more consistent than when they are allowed to attack the pitch whenever they want to. The standard deviation of trials on Part I will be significantly lower than those on Part I.

As already noted, only three of the 18 EMG measures yielded values of t which would support the hypothesis. Four measures moved in the opposite direction and 11 produced no change. The data,
then, seem to argue for acceptance of the null-hypothesis: Specifying the attack time does not generally help singers organize their preparatory set in a way which is more consistent from trial to trial. Further research is suggested, especially since subjective evidence does indicate a relationship between rhythmic pulse and efficient phonation: Singing teachers and choral directors commonly state that tone quality and freedom suffers when the singer is unsure of the rhythmic lead-in to the attack.

Because a number of significant \( t \) values were obtained using changes in standard deviation as a measure of response consistency, such an approach may be useful in future research on preparatory set. In fact, comparing the consistency of an individual's preparatory responses for a number of trials under different conditions may be more significant than comparing the mean EMG values themselves. The condition which produces the smallest deviation among repeated trials is likely the one which is allowing the subject to organize the existing preparatory response more efficiently.

The large changes in variance noted in Table 9 indicate that the rhythmic track helped some subjects and distracted others. The Yerkes-Dodson Law (1908) states that there is an optimal level of arousal at which performance is best. This ideal level lies somewhere between low arousal and high arousal. At both ends of the spectrum performance deteriorates. Hamann (1982) found that increased anxiety actually facilitated musical performance for subjects possessing a high level of task mastery.
The rhythmic click track of Part II probably stimulated higher arousal levels than on Part I. Subjects who had been functioning within their optimal range for Part I may have been made nervous by the track, thus causing a change in preparatory behavior. Other subjects may have been functioning with too little arousal in Part I and been boosted into their optimal range by the click track. This would suggest that an individual's preparatory set is subject to changes in arousal level. Increasing the arousal level may result in a more consistent response for one person while it causes a breakdown in organization for another.

This interpretation is important for vocal pedagogy. A singer may begin the first phrase of a song at the wrong time, and the teacher may point out the error. The next time through the piano introduction, the student, operating at a higher level of arousal, may succeed in starting the phrase on the proper beat. The tone quality, however, may be pinched and hesitant. Another student, after having received the same correction, might find that the additional awareness enables him or her to synchronize the timing of his inhalation and sharpen his mental image of the tone so that the attack is more efficient. The same directive which hinders the preparatory response of one student might enhance the response of another.
CHAPTER V

SUMMARY AND CONCLUSIONS

Overview

This study was based on the premise that a singer's tone quality and freedom are dependent on his or her preparatory set. The purpose of the study was to determine the impact of preparatory set in singing and thereby establish foundations for future work on the subject.

In conjunction with this primary purpose, the study also sought to add to the experimental data on the Alexander Technique by using Alexander training as a treatment. In addition to being able to observe the application of the Technique within a controlled setting, the author hoped to gather information about the relationship between the Technique and preparatory set.

The study used identical pretest and posttests separated by 10 days of treatment. Twenty-three subjects were recorded singing a short song. Twelve representative subjects from this population then underwent EMG testing which monitored the preparatory activity of three muscles—right sternomastoid, left sternohyoid, and right upper trapezius—during the singing of single tones on the vowel [a]. The subjects were instructed to sing back pitches that were played for them, either whenever they were ready (Part I), or on a specific beat as indicated by a rhythmic click track (Part II). Two
different pitch classes (high and low) were used, and before each trial a loudness level was specified (loud or very loud).

Three matched treatment groups met under similar conditions for one hour during each of the next ten consecutive weekdays. In addition to an introductory course in the Alexander Technique, the other treatments consisted of progressive relaxation activities (Body Awareness Group) and a regimen of standard vocal exercises drawn from published voice class textbooks (Vocalization Group).

Three hypotheses were tested. The first was that the treatments would produce significant changes in tone quality as determined by expert evaluators, and that the Alexander group would show the most improvement. The second was that this improvement in tone quality would be correlated with observed changes in preparatory muscle behavior. The third was that preparatory behavior would be more consistent when the moment of the vocal attack was specified through the use of a rhythmic click track.

**Summary of Findings**

Analysis shows no significant difference among the three treatment groups with respect to change in perceived tone quality after treatment. Individual \( t \) tests comparing each group’s change score to zero (no change) revealed that the Vocalization group posted an actual decrease in vocal quality after treatment, but this effect is explained by the fact that this group had a higher pretest mean score. A post hoc ANCOVA, which compensated for this inequity, confirmed that group posttest scores were not significantly
different at 0.05. It is surmised that the overall lack of positive change was due to the shortness of the treatment time.

The effectiveness of the Alexander treatment was undoubtedly influenced by the subject selection process inherent in controlled experimentation. By necessity, the experimental subjects did not match the profile of real-life beginning Alexander students in terms of motivation for study, incoming knowledge of the Technique, and trust in the teacher. This means that the Alexander training observed may have been atypical. This limitation is likely to be present in any controlled study that seeks to examine Alexander training. A prolonged treatment time might mitigate but would probably not eliminate this problem.

The Alexander treatment sessions did not use singing activities as much as the other treatment groups did. Although more task-specific activity (especially using more strenuous production as required during the audio taping and EMG testing) might have produced greater improvement in tone quality, such training probably would have violated a basic principle of the Alexander Technique, namely the need to avoid "end-gaining" (see pp. 27 and 107). Finding the ideal balance between conceptual and practical application should be a priority for future research using Alexander training as a treatment. The fact that the Body Awareness treatment did not produce improvement is somewhat surprising. Subjects engaged in continuous relaxation activity during each session and strong emphasis was placed on applying relaxation skills directly to singing. In addition, relaxation was a familiar concept requiring
far less orientation than the more unusual principles of the
Alexander Technique. It is possible that the relaxation activities
causd subjects to collapse their postural support, in spite of
efforts to establish a distinction between balanced relaxation and
harmful collapse. Subjects sometimes reported that their singing
felt anemic or dull when relaxing.

The lack of significant change in singing tone quality prevented
acceptance or rejection of the second hypothesis, that improved tone
quality would be accompanied by changes in preparatory set activity
as measured by EMG. The EMG data was thus examined independently.

Significant changes occurred in a number of selected EMG
variables. The fact that these changes occurred without causing
changes in tone quality indicates that neuromuscular control of
singing is very flexible: The subcortical coordinative systems may
actually tend to compensate for changes in preparatory muscle
activity in an attempt to keep the output—the tone—unaffected.

The directive to sing "loud" did not produce significantly
different EMG readings than the directive to sing "very loud."
While this lack of difference may simply be a function of the
particular muscles monitored here, it is possible that once the
dynamic level reaches forte, greater loudness is produced by
mechanisms that do not influence preparatory set. Higher pitches
produced significantly different EMG activity than lower pitches for
a number of variables. Based on the conjecture that higher pitches
would elicit less efficient preparatory sets, it is suggested that
improved set might be characterized by lower EMG peak values, more
gradual onset slopes, increases in peak lead time, and increases in the lag time between the peaks of some muscles.

The EMG data show group-time interaction effects for seven of the 18 EMG variables. There is no overall pattern to the interactions which would have indicated a clear difference between the three treatment groups. The Body Awareness and Vocalization groups did change in the opposite direction from each other in six of the seven interactions. Since these same two groups had also posted the largest difference in change scores on the audio testing (very nearly significant at 0.05), the data suggest that future research may well establish correlations between improved singing quality and specific changes in preparatory muscle activity.

The group-time interaction plots also show that the Alexander treatment subjects were able to influence the activity of the upper trapezius muscle much more than the subjects in the other groups. Inasmuch as Ms. Conable stressed the need for freedom in the muscles of the back of the neck, the EMG changes suggest that the Alexander training begins to produce measurable changes in muscle behavior rather quickly.

The third hypothesis predicted that preparatory set would become significantly more consistent (more similar from trial to trial) on Part II of the procedure, in which the moment of the vocal attack was specified using a rhythmic click track. Analysis using a t test for dependent samples shows this to be the case for only three of the 18 EMG variables tested. Four variables had significantly less
consistent EMG patterns under the rhythmic condition. The remaining
11 variables remained stable.

Introducing the rhythmic pulse did, however, dramatically
increase the variability for many of the EMG measures (as much as
405%). Some of the subjects became much more consistent with the
rhythmic pulse while others became much less consistent. This was
interpreted in light of the Yerkes-Dodson arousal theory.
Preparatory set behavior is clearly related to level of arousal.
Both insufficient and excessive arousal may produce inefficient
anticipatory muscle activity.

Conclusions and Implications

While Chapter I of this study described the need for research on
preparatory set in singing, the experimental portion of the study
showed this phenomenon to be an extremely complex psychomotor
response, difficult to examine systematically.

Some general observations may first be made in response to the
informal questions mentioned in Chapter I. The first question was
whether singers display highly individual patterns of preparatory
behavior. The data seem to indicate that this is the case. After
working with the plots of the 12 EMG subjects for a period of time,
the author was able to distinguish one subject’s plots from those of
another. He could also usually identify plots belonging to a
specific subject by examining the characteristic onset time and
slope patterns which were displayed on the plot.
While these patterns were highly individual, subsequent study may reveal a limited number of general response patterns. In terms of EMG onset time, most subjects tended to be either early starters or late starters. Following the onset of muscle activity, some subjects showed steady upward slopes through to the moment of attack, others quickly reached a peak and remained there through the attack, and a third group reached early peaks and then declined through the moment of the attack. In spite of changes in certain EMG measures (and the indication that longer treatment times and more sensitive EMG procedures will record even greater changes), preparatory muscle set does seem to be generally stable from one vocal attack to the next. It is clearly not a random behavior but a highly organized conditioned reflex which is resistant to change.

This study indicates that preparatory muscle activity can change without causing a change in perceived vocal tone quality. While a number of experimental variables may have influenced this effect (e.g., the specific muscles and electrode locations used, the limitations of surface EMG, and the variable reliability of expert evaluators), the result is consistent with related research. Neuromuscular control systems possess a great deal of flexibility: The same output can be produced using a fairly wide range of preparatory muscle balances. On the other hand, this flexibility is certainly limited.

The implications of this research study for vocal pedagogy are large, but no general overhaul of practical studio or rehearsal procedures is anticipated. When a choral director uses a smooth,
expansive preparatory gestures in order to produce freer, more relaxed tone, it is an implicit acknowledgment of the importance of preparatory set. The quotations found in Chapter I (see p. 16) clearly demonstrate that the "getting-ready-to" phase of singing has always been regarded as important in the voice studio and choral rehearsal. None of these quotations is more striking than those of Garcia (1894): "All control over the tone is lost once the vocal tone becomes vibratile" (p. 12).

Thus, this study will stimulate conscious consideration of something which has hitherto been an unconscious part of vocal teaching. It provides a psychological and physiological framework for understanding the nature of preparatory set as it relates to reflexive habit formation. The experiment demonstrates that a singer's anticipatory muscular activity is a highly individual, stable response which appears to be resistant to change. It is hoped that a greater awareness of this phenomenon may encourage teachers of singing to enlarge their field of awareness, that is, to be attentive to a wider range of the subtle behaviors that occur during the preparation for attack. Such heightened perception would almost certainly produce more careful use of imagery and lead teachers toward a psychological rather than a mechanistic pedagogy.

A greater respect for the influence of preparatory set should tend to focus greater attention on the process of singing. The twin goals of increased kinesthetic awareness and the simple application of inhibition should be consciously pursued by teacher and student. Teachers know from experience that most often their students simply
need to get out of their own way, to let the tone go. Experimental study of preparatory set should help corroborate this subjective knowledge and lead to more effective teaching.

**Suggestions for Future Research**

This exploratory project was carried out in the hope that it would produce ideas which could guide future research. During the implementation of the experiment and subsequent data analysis, many such suggestions were noted and catalogued. The following, a brief overview of some of the most interesting suggestions, could have been expanded upon almost indefinitely.

Investigators of preparatory set in singing should not attempt to measure treatment effects until much more is known about the phenomenon itself. Preparatory muscle behavior is very complex and largely covert: Researchers will need to work within very narrowly defined objectives and maintain careful control over a large number of experimental variables. It would be advisable to avoid pretest/posttest designs and to focus on single-session EMG testing using the largest practical number of subjects. This will permit EMG data to be used with more confidence.

EMG does seem to be an effective means for directly observing preparatory set, but thorough analysis will clearly require the use of intrusive electrodes. The anticipatory response patterns of the laryngeal muscles or laryngeal support muscles as well as those of the breathing musculature (such as the intercostals and diaphragm) must be examined using needle or fine-wire electrodes. In spite of
greatly increased procedural complexity and the problem of finding willing subjects (especially trained singers), intrusive electrodes will permit investigators far greater freedom in choosing muscles for study and will yield more precise EMG signals which can be interpreted with greater confidence.

When surface electrodes are used, it is suggested that the upper trapezius and sternomastoid muscles continue to be tested because both muscles are involved in maintaining the tonic postural balance of the head. Videotapes should be examined to identify EMG activity caused by head movements unrelated to preparatory set, and analysis of sternohyoid activity should take into account its accessory role in opening the mouth.

Researchers may identify other superficial muscles to examine using surface electrodes. Indirect measures of respiratory response may be taken by using certain muscles of the back. Whatever the muscles, surface electrode data should be compared with results of intrusive electrode studies to determine how strongly the preparatory activity of peripheral muscles is correlated with that of the laryngeal mechanism itself.

The EMG normalization used here seems to be appropriate for use in future studies, but tasks designed to obtain "maximum" values for muscles will need to be developed with great care. Procedures that work well with large muscles (having well-defined and easily monitored angles of pull) may not be best for measuring maximum capacity of muscles in the laryngeal area.
The EMG plots in this study were interpreted using six values. The Peak, Peak Lead, Peak Lag and Slope measures each yielded at least one significant group/time interaction effect (three for Peak), while measures derived from onset time (Onset Lead, Onset Lag) were less responsive. More research is needed to determine what kinds of measures most accurately define preparatory muscle behavior in EMG studies.

Future studies may perhaps supplement EMG data collection by recording autonomic functions such as galvanic skin response, blood pressure or pulse. Computer analysis of videotapes (such as is currently used in gait analysis) may also be useful in studying the preparatory movements of singers, provided the movements are large enough to be accurately measured. Another area of potential research could involve investigation of the roles of fast-twitch versus slow-twitch muscle fibers in preparatory set behavior. This could be studied by examining EMG frequency instead of integrated amplitude.

Single-tone attacks using an open vowel, as used in this study, are recommended for future research. Experiments should be designed so that many EMG observations of the same vocal task can be made in order to permit stronger statistical analysis. In doing this, however, researchers should avoid merely having the subject repeat the same pitch in immediate succession. Such a procedure would undoubtedly alter the preparatory behavior by introducing a different task attitude and expectancy level. A sound level meter should be used to provide an objective measure of loudness.
Specifying the moment of attack through the use of some kind of rhythmic cue is suggested.

Videotapes of EMC sessions should be carefully controlled in terms of camera distance, angle and zoom lens setting in order to facilitate comparisons between subjects.

Rationale for the selection of each subject's pitches should be carefully considered in order to insure that all subjects are singing tones of comparable difficulty. Register change points as well as individual vocal characteristics need to be taken into consideration. It is actually quite likely that registration is an important influence on the preparatory muscle activity of singers.

This study indicates that, once a singer is singing at forte, further increases in loudness may not have much effect on preparatory set. Subsequent research should first monitor different muscles to determine if this is a general effect rather than a peculiarity of the particular muscles monitored here. Studies should then collect data which compare forte and piano attacks in order to see if significant changes occur.

It is important to determine how preparatory set is related to perceived tone quality. It would be very interesting, for instance, to compare the preparatory EMC patterns of a group of excellent singers (as judged by a panel of expert evaluators) with the patterns of a group of poor ones. In any study using voice teachers as evaluators, the criteria distinguishing "excellent" from "poor" vocal quality should be defined as carefully as possible (without making the evaluation process too cumbersome). The development of
standardized criteria for evaluating tone quality would be of great value to future research in singing.

In addition to experimental studies, further descriptive research should be provided for the vocal teaching profession. While it has been shown that teachers use pedagogical techniques every day which are intended to influence what singers do before phonation begins, few are aware of the implications of these procedures. Vocal researchers should join with psychologists to examine preparatory set in the light of various information processing models and other cognitive theories.

Discovering relationships between Alexander training and specific EMG changes must await the accumulation of much more knowledge about preparatory muscle set. The effects of the Technique on singing performance should, however, be actively investigated. To date, there has been no replication of the pilot study by Jones (1972; see p. 64), which sought to identify changes in tone quality occurring in immediate response to Alexander influence (the hands-on assistance of a trained teacher). Either expert evaluators or modern spectrographic analysis could be used in such a study.

Further studies using Alexander training as a treatment should arrange the longest possible treatment time which still permits adequate experimental control. The subject selection problems discussed in Chapter IV (see p. 105) should be addressed.

Finally, the question of task-specificity during Alexander training should be addressed. Using the Alexander Technique as a
treatment—as a means to achieve measurable changes in some other activity—raises a question which is very important to Alexander teachers. Where is the dividing line between theory and practical application? Alexander himself spent a great deal of his time resisting the efforts of former students who attempted to "use" his teaching methods in order to produce immediate improvements in particular activities. He argued that old habits automatically reassert control whenever awareness shifts away from the process (kinesthetically monitored inhibition and release of the primary control) and focuses on the desired output (the activity itself). This urge is particularly strong for the beginning student. On the other hand, singing teachers need to understand how they can apply the Alexander's principles in practical ways. How much and what kind of singing activity can be used during such training without violating the underlying principles of the Technique?

Further research is recommended on relaxation training as an aid to singing. Can a relaxation training regimen be developed that reduces unnecessary preparatory muscle tension but does not also cause postural collapse and lethargic, anemic tone quality? What are the potentials and limitations of relaxation activities in vocal pedagogy, especially in light of the nature of habitual preparatory set?
APPENDIX A

HUMAN SUBJECT CONSENT FORM
CONSENT FORM FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

(OSU Protocol No. 87 B 00302/26/87)

I, ________________________, hereby consent to participate in
research entitled "EMG Study in Singing," conducted by Dr. James E.
Major and his authorized representative Robert Engelhart. Mr.
Engelhart has explained the purpose of the study, the procedures to
be followed, and the duration of my participation.

I acknowledge that I have had the opportunity to obtain
additional information regarding the study and that all my questions
have been answered to my satisfaction. Further, I understand that I
am free to withdraw at any time and to discontinue my participation
in the study without prejudice to me. The information obtained from
me will remain confidential.

Finally, I acknowledge that I have read and fully understand
this consent form. I sign it freely and voluntarily. A copy has
been given to me.

Date____________________ Signed____________________

Signed____________________
(Dr. James E. Major,
Principle Investigator)

Signed____________________
(Robert Engelhart,
Investigator)
APPENDIX B

SONG USED IN AUDIO TEST
\[ j = 100 \]

\textbf{piano}

\textbf{mf My country}

\textbf{piano}

\textbf{tis of thee, sweet land of liberty, of thee I sing! (piano)}

\textbf{piano}

\textbf{And the rocket's red glare, the bombs bursting in air, (piano)}
APPENDIX C

ABSTRACT OF DAILY TREATMENT SESSIONS,

ALEXANDER GROUP
ABSTRACT OF DAILY TREATMENT SESSIONS,
ALEXANDER GROUP

Session I

Subjects seated in straight chairs in circle. Author introduces Barbara Conable. Ms. Conable mentions that she has not previously taught a group that knew nothing about the Alexander Technique. She hopes the experience will have life-long benefits (3 minutes, 30 seconds).

Without giving a detailed description of F. M. Alexander’s experience, Ms. Conable begins describing the primary control, “an inherent pattern of support and balance in the body... when operating normally it lets the body feel free and light and comfortable. When we’re heavy and effortful we’re interfering with the primary control.” The emphasis is on getting out of our way and letting the natural balance take over. At the core of this interference is excessive tension in the muscles of the neck. She uses a handout, skeleton and wall chart to point out that our personal anatomical maps are often quite wrong; neck muscles are longer, the joint between spinal column and skull is higher, and the neck is much longer than we usually think (4 minutes, 30 seconds).

Ms. Conable starts around the room unobtrusively as she discusses the touching done in Alexander training. It is not massage or chiropractic. It is most similar to what a good music teacher does when he can’t verbalize what he wants. If the muscles of the neck are tight, everything else will be too. The neck is the only place in the body where this is so. When neck muscles tighten, the head moves toward the floor and tilts backward, the chest collapses, shoulders curl, ribs tighten. We try to relieve tightness by dropping back on the pelvis. This creates extra pressure on the spine and lower body. In short, a global effect, a whole body pattern. Ms. Conable demonstrates these postural distortions as she moves slowly from subject to subject (9 minutes).

More work with skeleton to show how head ought to balance on the spine (1 minute).

Ms. Conable resumes turns around the circle. What does this have to do with singing? The function of the neck muscles is to support and move the head. Though they would dearly love to do so, they can’t sing (effective humorous approach). The singing muscles are like insects in the midst of giants, dominated by tension in the big neck muscles. The resulting tightening of the ribs restricts air supply. Good singers don’t tighten the muscles of the neck (8 minutes).
Gentle singing of "Row, Row, Row Your Boat." Notice neck muscle tension. Some subjects do not notice anything. Ms. Conable points out that this is usually the case since we are not used to giving attention to neck muscle tension. She remarks that she observed considerable tightening around the room during the singing. It is remarkable that we can tense our neck muscles as much as we do, year after year, since this interference requires lots of effort (6 minutes).

Ms. Conable had subjects sing single pitches while slumping down in chairs, and then contrast the sensations with those of singing with greater lightness and freedom in the neck. "The little muscles [larynx] work better when the big muscles aren't being tyrants" (2 minutes).

Further individual work during discussion of how neck muscle tension causes weight to be rocked back on heels. We feel tension and fatigue in the back when the neck muscles are tight. Concentrate on balanced weight distribution related to the release of the neck (8 minutes).

Sang middle range pitch on vowel [a]. Notice difference between collapsed posture (tight neck) and released one. Big difference in low part of breathing. Ribs can move when the neck is free. Various concluding comments (8 minutes).

Total time: 50 minutes

Session II

Ms. Conable begins individual work immediately. She asks if anyone has questions (no response). Reviews previous material. When we sense effort in movement something is wrong, and this interference is likely to be a downward pull of the muscles of the neck. If this is occurring, directives like "don't lock your knees" are ineffective; if we unlock the knees we just have to tighten something else (6 minutes).

Introduction to the kinesthetic sense, comparison between it and sight, hearing, touch. We are not taught to perceive kinesthetically, so the sense is not part of our conscious awareness. Retrieval of kinesthetic awareness is effortless and instantaneous; we only need to choose to give attention to it. It is hard to deal with kinesthetic information because we have no familiar labels to assign, as with auditory or visual stimuli. Even postural directives ("your posture is bad") are given in visual rather than directly kinesthetic terms. As we grow, our kinesthetic sense of size often doesn't keep up with our real growth. This is one of the reasons for slumping (11 minutes).
Decide, using a 1 to 10 scale, how much effort you use in raising and lowering your arm. This is a kinesthetic judgment of "easy" versus "effortful." Tightening arm muscles will make the movement a little more effortful, but tightening the neck muscles (with the inevitable slumping) makes the movement much more effortful. In same way, evaluate degrees of "tension" versus "freedom" in the movement. The best way to get the most tension is to tighten the neck muscles (7 minutes).

The term Gestalt refers to "the content and organization of your consciousness at any moment." A Gestalt may either include or exclude a kinesthetic component. Singers need a Gestalt which includes auditory, visual and kinesthetic elements in an ideal mix. The great singers know what they are doing with their bodies (7 minutes).

Ms. Conable tells subjects (seated) to "get ready" to sing, then asks whether this process produced freer, lighter feelings (general consensus of no). Rather, "getting ready" created tension and made them less ready to sing. This makes no sense; "we get ready in a way that makes it harder to do it." Instead, why not find the release of the head and neck; think light, free, easy (5 minutes).

Yawn-sigh exercise, first all together and then individually as class watched. Ms. Conable pointed out very noticable patterns of grab in the head and neck. This activity was then repeated with Ms. Conable giving manual guidance. Subjects reported novel sensations, less effort. In approaching any activity, we have three choices; a) actively tighten the neck muscles b) try to do nothing with them (inhibit) c) actively free them by moving up. During singing class, experiment with the kinesthetic dimension. "Playfully and sincerely examine these ideas...ask yourself, 'is it so?'" Final turns around circle, repeat of yawn-sighs (17 minutes).

Total time: 53 minutes

Session III

Tape begins with session already underway. Ms. Conable is answering a question from a subject who had experienced dizziness when trying to apply the ideas on her own. While temporary dizziness may result from increased blood flow caused by release, it is usually the result of some added push or tension which has been unknowingly introduced. There is further questioning of subjects during casual individual turns. Question: these ideas seem useful in an isolated setting, but do they apply in practical activity? Answer: let’s see by applying it to the practical activity of reading while seated. Ms. Conable works with subjects while reading to get greater freedom, etc. Note free range of motion available. We are not talking about a particular position but a quality of ease and freedom. Various turns with individual subjects (11 minutes).
Review previous material. Neck muscle tension has universal effect on all other parts of the body. If a teacher is not aware of this, he will attempt to deal with visible tensions piecemeal. Neck muscles must truly be free (not just look "stretched") for the benefit to occur. If we carried as much tension in our elbows as we carry in our necks, we'd go to the doctor because we'd notice it. We must learn to notice kinesthetically. Stage presence is simply being awake kinesthetically (10 minutes).

Ms. Conable uses skeleton and handout of lateral view of body to show that the line of postural support is farther forward than we usually think. The head is supported in the middle, and is designed to balance comfortably. Weight is distributed widely onto the pelvis. When proper balance and freedom is lost, the pelvis gets pushed forward. This causes a false sense of where the hip joints are. Subjects explore true location of hip joint (11 minutes).

Individual turns with rest of class observing. One subject's uncomfortable feeling that his shoulders are too far forward is due to his habit of pulling them back. Another subject feels that Ms. Conable is pulling him through a walking movement when almost no actual contact is being made. Tape ends with session still underway (16 minutes).

Total time: 48 minutes

Session IV

Tape begins with Ms. Conable distributing handouts showing laryngeal structures and organs of respiration. Note how small the laryngeal muscles are in contrast to the surrounding neck muscles. Excessive contraction of the neck muscles causes dropping of the larynx, retraction and stiffening of the tongue, and constriction of the pharyngeal passage. Notice how high the lungs lie relative to the collarbone; even above the first ribs. The flexibility of the top ribs is very important. No amount of work in the lower body will compensate for stiffness in the upper ribs. "Alexander teachers, in addition to being concerned about lower support, are very concerned about flexibility of the ribs that surround the body of the lung." When interference is removed, you should feel breathing from the top of the torso to the very bottom. "It is true that one shouldn't raise the rib cage. But if the ribs are stiff, up and down movement is a necessary compensation." Greater overall freedom in the ribs is a prerequisite to dealing with the high clavicular breath (14 minutes, 30 seconds).

Individual turns. One subject notices that her normal respiration pattern is very different from her breathing for singing. Ms. Conable continues to move from subject to subject as she discusses breathing freedom and various matters, below. The
ribs move in response to the air coming in. A number of subjects notice that collapsing the body balance causes difficulty in breathing. Ms. Conable keeps emphasizing rib freedom; "breathing should be a 24-hour massage." A subject asks if Alexander training improves muscle tone. Ms. Conable comments that it tends to produce a more uniform tone by bringing the whole body into a balanced state. "Work" should not be gauged by the amount of effort we feel. Muscle tension can be either obvious or subtle. The word "relax" is misleading because of the connotations it carries. "Align" is a pretty good word, except when used by dancers to denote "stacking up the spine." Tai Chi and Alexander are compatible. One subject likes to sit in a curled over position. Ms. Conable shows her how even such a position can be done in an easier manner which doesn't restrict breathing freedom. Tape ends with session still underway (41 minutes).

Total time: 55 minutes, 30 seconds

Session V

Tape begins with individual work underway and Ms. Conable discussing two approaches to bending the neck forward. The most efficient is to simply let the actual head/neck joint tilt; the other is to pull the entire neck forward. Even hunching over can be alright if the body is allowed to move in sequence (5 minutes, 45 seconds).

Alexander training is useful for helping people fall asleep. Most positions are fine for sleep except on the side with knees on top of each other. Tomorrow's session will be "activity day." Come prepared to do some familiar activity. It is important to discover how the Alexander Technique relates to the normal things you do with your body (4 minutes, 15 seconds).

Ms. Conable asks the entire group to sing something together. The group chooses "Simple Gifts" (key of F major). Ms. Conable encourages each person to notice where his or her attention is (the Cestalt) and sense what is happening during the preparation for singing. She works carefully with one subject to release neck tension and resultant breathing constriction. The singing inhalation cannot be taken irrespective of where you are in the natural breathing cycle. Time the vocal attack so that it coincides with the natural in-and-out of respiration. The subject repeats the phrases and the class comments that the tone is clearer with better diction (12 minutes).

Ms. Conable listens to two other subjects sing and suggests that each of them tends to allow the field of awareness to shrink right before the attack. Be careful to remain aware of the room around you and people in it; don't retreat inside of yourself but remain simultaneously aware of the outside world, your kinesthetic
information, and the requirements of the music. This is difficult but possible. Frank Jones called this a unified field of attention (15 minutes).

Four more subjects sing. Ms. Conable encourages each to avoid freezing the muscles of the neck and to retain this freedom throughout the singing. Each subject repeats the same phrases several times following suggestions and manual assistance from Ms. Conable. In most cases, the phonation sounds more relaxed, and some subjects seem to achieve better register transitions (17 minutes).

All subjects sing together while standing, this time with piano accompaniment. General comments from Ms. Conable. Tape ends with discussion still continuing (2 minutes).

Total time: 56 minutes

Session VI

Tape begins with session already under way. Ms. Conable is giving short individual turns to the subjects. Today is going to be "activity day," in which each person may explore some familiar activity and see how the Alexander Technique may be applied to it (3 minutes, 30 seconds).

One subject has brought in her racing bicycle. With others holding the bike upright, Ms. Conable helps her find a more efficient way to assume racing position by releasing her head and lengthening the spine as she crouches. Ms. Conable also observes her manner of getting on and off the bike and shows how the Alexander Technique can make this action easier (7 minutes, 30 seconds).

Another subject wants to apply her Alexander training to her typing. Ms. Conable shows her how releasing the primary control produces greater freedom in the arms and fingers. She emphasizes that it is all right to crouch over the typewriter if you wish to, as long as the curling is done with the "head leading and the body following" (5 minutes, 30 seconds).

Another subject performs mock kitchen tasks, such as cutting vegetables or washing dishes. Ms. Conable’s assistance reveals the presence of much unnecessary muscle effort, and the subject is shown a more efficient way to lean over the counter (6 minutes, 30 seconds).

Working with a subject who plays guitar, Ms. Conable explains that instrumentalists often have a psycho-physical response to the instrument itself which must be recognized and changed. Merely picking up the instrument causes habitual tension to appear. She encourages the subject to explore the guitar as an object rather than see it as an adversary. Kinesthetically discover the weight,
shape, and texture of the instrument without thinking about playing it. This experience often helps instrumentalists identify neck muscle tension and other "grabs" which have been occurring as part of the preparation to play (7 minutes, 30 seconds).

Another subject does sit-ups with Ms. Conable assisting. She also wants to know if the Alexander Technique helps with getting to sleep. Ms. Conable says that just about any position seems to be fine for sleeping as long as the head is allowed to release and the body allowed to follow by lengthening (9 minutes, 30 seconds).

Any time you become aware that you are not physically comfortable, first use the kinesthetic sense to find out what you are really doing with your body as a whole. Then ask yourself what is happening in the muscles of the neck and begin to release tension here. At the same time, remember that movement can only occur at joints, and kinesthetically redefine where the joints are that are involved in the movement. If our kinesthetic "map" of our body is inaccurate, we will not move efficiently. The Alexander Technique is best learned by applying the ideas to familiar movements throughout each day, whenever we happen to think of doing so. Our experiences with familiar movements provide a base for applying Alexander to new kinds of activities (9 minutes).

Ms. Conable asks how the group's singing has been outside of class. Various subjects reported some improvement. Ms. Conable again warned against narrowing the field of awareness when working with Alexander. Don't stop being aware of people and objects around you. Another subject said that he was very nervous during singing. Tape ends with discussion continuing (6 minutes, 30 seconds).

Total time: 55 minutes, 30 seconds

Session VII

Tape begins with session underway and Ms. Conable going around the room giving individual turns to each subject. As she works, she is explaining that this training is only an introduction to the Alexander Technique. A full beginning course would be much more extensive. In response to a question, she states that the benefits of Alexander training are not limited to any particular kind of movement. Since the goal is to restore natural function, the benefits ought to be able to be applied in any situation. The key is it all is noticing-learning to be kinesthetically aware of what you are doing. This awareness offers us a choice of how we will move, and we stop being the slaves of unconscious habits (9 minutes, 30 seconds).

A subject reports that she has been "trying to concentrate" on applying the training but that it often seems to produce more tension. Ms. Conable answers that most "concentration" involves a
severe narrowing of the overall awareness. Don't allow this to happen. Take in your whole body as well as your whole environment. Don't focus all your awareness on a single area (1 minute, 30 seconds).

Ms. Conable describes the work of Rudolf Magnus on vertebrate reflexes. His work is a physiological confirmation of what F. M. Alexander discovered. In vertebrate movement, when the head leads and the body follows. To the extent that this pattern is interfered with, movements will be less efficient. The organization and pattern of movement is incrementally affected by whatever amount of neck muscle tension is present. Race horses must be trained to respond to the bit by lengthening their necks. This facilitates the gait and increases speed. When cats are prevented from lengthening their necks (through the use of special collar), their movements become clumsy. Each subject gets a turn leaning forward and then back in a chair (20 minutes, 30 seconds).

Subjects walk around the room, first in a slumped state and then with the head and neck free. Notice the difference. One subject comments that "everything seems to follow the head." Ms. Conable again states that the Alexander Technique does not try to replace one set of behaviors with another. The goal is increasing freedom to choose how one will move based on awareness. Each subject given individual attention to their pattern of walking. (Some conversation here; not everyone was paying attention to her work with other people) (14 minutes).

After everyone is seated again, Ms. Conable says that every part of a movement should be seen as relating to an overall pattern. Don't try to fix some isolated part of the action without being aware of the whole. Tape ends with discussion clearly not finished (5 minutes).

Total time: 50 minutes, 30 seconds

Session VII

Individual work as class arrives. Ms. Conable is asked how her children reacted to the Alexander Technique as they grew up with it. She comments on the damage caused by forcing children to sit still for long periods of time (4 minutes, 30 seconds).

Turns continue during discussion of the mobility of the head. Definition of a joint: bones meeting so there can be movement. Thus, movement can only take place at joints. Ms. Conable works with each subject to explore the full range of motion of the head and neck. The head should be able to rotate a full quarter-circle. This can't occur when we are collapsed (class tries it to confirm). The head should also be able to tilt back much farther than we might think. The class is amazed at how much tilting occurs in various
subjects when Ms. Conable assists in keeping the neck muscles free (12 minutes).

Ms. Conable gives individual turns with subjects doing movements of their choice, including back bends and dance movements (19 minutes).

Each subject sings a phrase from a song of his or her choice as Ms. Conable provides assistance. Other subjects usually notice improvement in tone. Ms. Conable cautions subjects against turning their attention inward when getting ready to sing. Rather, remain aware of the room and the people in it. Attending to the kinesthetic sense should enlarge the overall awareness (the Gestalt) rather than cause a withdrawal or shrinking. After individual turns, all sing "Simple Gifts" in unison as Ms. Conable goes around room giving brief assistance to each subject (21 minutes).

Total time: 56 minutes, 30 seconds

Session IX

Tape begins with Ms. Conable already working with a subject on his tennis serve. Let the neck release and lengthen, don’t restrict your awareness. A subject asks how long it takes to become an Alexander teacher. Ms. Conable briefly describes the 3-year training course and gives a little of her personal experience with the Technique (7 minutes, 30 seconds).

The Alexander Technique has a very good indirect application to overcoming stage fright. We can learn to respond to anxiety by lengthening and freeing our necks rather than pulling them down (3 minutes, 30 seconds).

One subject says that she experiences a "lack of breath control" during singing when she applies her Alexander training. Ms. Conable calls her attention to the preparatory wiggling which she does when getting ready to sing. Does this movement really do anything for you? The subject sang a song phrase several times as Ms. Conable helped her release neck tension and allow the body to follow. Adopt a "fooling around," experimental attitude toward applying Alexander to your singing. Don’t allow your focus to become narrowed within yourself. Remain aware of your surroundings (9 minutes, 30 seconds).

Discussion of the term primary control as used by Alexander. The body possesses a natural, reflexive way of balancing itself and coordinating movements. As we grow up, we learn how to interfere with this natural balance and make movements effortful. A feeling of effort in moving indicates that we are compromising the natural flow and support of the body (4 minutes).
Stand and calmly find your most effortless posture for singing. Then tighten the muscles of the neck and see what happens. Notice the contrast. When the primary control is free, there is a sort of "kinesthetic hum." We can't always make the right thing happen, but we can learn to get out of the way and stop interfering with natural function. Don't look for an isolated sensation in the neck; everything is interconnected. The neck starts to free up and the body responds as a unit, a whole body experience. Most of the time, when you notice tension, you won't be able to free it in isolation. Attack it as part of an entire pattern. Don't be cautious; this will narrow your awareness and create more tension (15 minutes, 30 seconds).

Ms. Conable repeats that "in vertebrate movement, when it is free, the head moves first and the body follows." Individual turns continue during this review. She asks the subjects if they have some sense of confidence in their ability to apply these ideas in the future. Tape ends with discussion near end (8 minutes).

Total time: 48 minutes

Session X

Tape begins with individual turns under way. Ms. Conable is commenting how each class member looks different than they did on the first day. Alexander training tends to be assimilated easily and remembered over time because it is natural (9 minutes).

Ms. Conable comments that "the Alexander Technique is a wonderful servant and one of the worst masters around." The subjects are encouraged to keep things in proper perspective and maintain a relaxed, inquisitive attitude as they apply Alexander to daily activity (6 minutes).

When you notice that you are heavy or uncomfortable, a) don't be in such a hurry to change b) take a moment to see where you are c) easily and smoothly begin a change, starting by releasing the head and lengthening the neck muscles. Each subject given a turn during this discussion (20 minutes).

Class sings "Simple Gifts" with piano accompaniment. Ms. Conable advises them to maintain kinesthetic awareness before singing and to keep their "Alexander wits about them." After the unison singing each class member gives feedback about how they felt. Comments from the class: "I just need to let my body alone;" "I feel freer and it's easier to sing;" "my breathing is freer;" "I can't seem to integrate inward and outward awareness;" "concern for getting the right words makes it hard to relax my neck;" "it feels better" (7 minutes).
Following these comments, Ms. Conable describes what she saw during the singing. There was still some freezing of the bodies, but much less than before. Let's repeat the song and see if you can improve even more. Class sings the song twice more, with Ms. Conable giving individual attention and answering questions (12 minutes).

Ms. Conable thanks the class for their cooperation and expresses her hope that this training will be useful to them in the future (1 minute).

Total time: 55 minutes

Average daily treatment time: 52.8 minutes
APPENDIX D

ABSTRACT OF DAILY TREATMENT SESSIONS,

BODY AWARENESS GROUP
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BODY AWARENESS GROUP

Session I

Introduction to progressive relaxation therapy, a review of Jacobson's work based on Bernstein and Borkovec (1973), pages 3-9. There is a close relationship between physical movement and psychological state. Progressive relaxation is designed to move systematically through the body and increase kinesthetic awareness of what relaxation feels like. This awareness increases one's ability to prevent tension by choosing to inhibit unnecessary effort (6 minutes).

Description of procedures. As you arrive, choose four or five floor pillows which will provide complete support in a semi-prone position, using the floor and wall as support for the pillows. Shades will be drawn and eyes closed during relaxation activities. Refrain from talking or unnecessary movement. Once session begins, tune out external noises and tune in to the kinesthetic information coming from your muscles. Subjects assume the semi-prone position and get comfortable (4 minutes, 30 seconds).

Preliminary directions. Repeated the above plus the instruction to stay alert during the session. This is not hypnosis or auto-suggestion. Rather, the goal is increased awareness and sensitivity to what is actually occurring in the body. The procedure will be to go through seven different muscle groups, first tensing the group for several seconds and then quickly relaxing the tension. Just notice what the relaxation feels like; it is not necessary to do anything, only to be acutely aware of the sensation of relaxation (3 minutes, 40 seconds).

Relaxation sequence (each group twice)
1. muscles of the dominant arm
2. muscles of the opposite arm
3. muscles of the neck
4. muscles of the face
5. muscles of the chest, shoulders and upper back (produce tension by inhaling deeply and holding it as you pull the shoulder blades together. Exhale on the release of the tension)
6. muscles of the abdomen (produce tension by inhaling deeply and holding it while making stomach hard. Exhale on the release of the tension)
7. muscles of the buttocks and upper leg
Tension cue: "ready... and... tense!" (tension sustained for 5-7 seconds.) Relaxation cue: "and... relax" (30-40 seconds for sensing relaxation. During this period, instructor maintains a steady stream of gentle reminders to relax, to notice, to be aware of the relaxation, etc.) (13 minutes, 50 seconds).

Short break. Subjects remain in prone position but are allowed to open eyes and ask questions if necessary (2 minutes, 45 seconds).

Repeat relaxation sequence. Same as above except each muscle group is done only once. There is a careful description of each muscle group and of the specific tensing that is to be done in each case. During the sequence there are continual, quiet reminders, such as; "sense your body," "the relaxation is under your control," "be aware and just notice what is occurring." During relaxation phase, subjects are asked to compare the state of relaxation in the current muscle group with that of previously done groups and to notice any differences (9 minutes, 55 seconds).

Review of the seven muscle groups. The groups are named in order as subjects maintained relaxed state. Notice interrelationship of the relaxation as it occurs throughout all the groups. Let go of tension you notice. Stay alert and be aware of the sensation. Notice your breathing pattern; How is it affected by the relaxed state? Feel the air move in and out easily as you remain aware of the relaxation (1 minute, 20 seconds).

Gradual "coming out" of relaxed state, summary. Slowly open eyes, begin some movement, take your time emerging from the relaxation. This training should have a cumulative effect; it is a process which takes time. You are free to practice the relaxation sequences if you like, but emphasis will be on what takes place in the sessions. The goal is to raise kinesthetic awareness of tension so that you can notice tension during singing and be more able to prevent or release it. This is not hypnosis or auto-suggestion (5 minutes).

Total time: 47 minutes

Session II

Review of yesterday's session. Recall the sensations, remember what seemed to work for you. Assume supported semi-prone position and close eyes (3 minutes).

Relaxation sequence. Same as in Session I, each group done once. Instructor reviews what muscles are involved in each group and how to tense and release them. More emphasis is placed on comparing each muscle group's relaxation level to that of previous groups (10 minutes).
Relaxation sequence with the seven groups reduced to four
1. both arms together
2. face and neck
3. abdomen, chest and upper back
4. legs, buttocks

All of the four groups are described before the sequence began. Then the sequence is done with one tension/relaxation for each group (9 minutes).

Short break. Open eyes and look around, ask questions, but remain in semi-prone position. The instructor discussed the need for a larger field of awareness, one which takes in both the kinesthetic sense and the outer world. Subjects agree that extraneous noise during sessions (i.e. planes flying over) is not bothering them (4 minutes, 30 seconds).

Repeat relaxation sequence with four muscle groups. Subjects were asked to concentrate on tensing each group without interrupting the relaxed state of the previous muscle group(s). Scan your body, notice the sensation of the absence of tension, just allow it to happen and notice (9 minutes, 45 seconds).

Now let's investigate the relationship between thought and tension. Think of a stressful situation, visualizing it clearly. Notice any physical tension which occurs. Jacobson found that when patients learned to relax the physical tension which accompanied certain thought patterns, the thought patterns themselves tended to disappear (2 minutes, 45 seconds).

The subjects emerge from the relaxed state and ask questions. Instructor gives a brief summary (3 minutes).

Total time: 43 minutes

Session III

Relaxation sequence with four groups. Same position and procedure as in previous sessions, using tension/relaxation alternation. Instructor restates purposes of the training and encourages subjects to sense even finer degrees of relaxation. Compare relaxation states of the various parts of the body, notice how the breathing coordination is affected by what you do (10 minutes, 30 seconds).

Introduction of relaxation by recall. The tension phase will now be eliminated. On signal ("ready...relax"), the subjects are to go directly from normal state to the deeply relaxed state which they had achieved during the previous sequences. Success in this is dependent on having developed a kinesthetic memory of how the complete relaxation feels. During the relaxation phase, keep
allowing the muscles to release more and more, and notice how the various muscle groups relax in relation to each other. Give attention to the quality of your breathing. Don’t "do" anything; simply notice what it happening. This procedure is done for the four muscle groups (8 minutes, 15 seconds).

Short break. Instructor explains recall relaxation to a subject who had entered late (3 minutes, 50 seconds).

Repeat recall relaxation with the four muscle groups (estimated 6 minutes. The tape failed to record the last part of this session. The conclusion of the summary was obtained from lesson plans.).

Introduce recall relaxation by counting. Subjects are first asked to rouse themselves somewhat. Following this a slow count is made from 1 to 10, during which they relax the entire body progressively, moving deeper into relaxation as each count is spoken. Upon reaching 10, one minute is spent being aware of the relaxed state (estimate 6 minutes).

Sit up with torso supported fully by the pillows but the head and upper back upright. Spend a few moments sensing the muscle effort needed to hold the head up. "Differential relaxation" is the skill of knowing what to relax and what not to relax. Subjects slump head into chest to feel total collapse of the neck muscles, and then moved the head slowly into an upright position. Subjects are asked to notice if they were using less effort (estimate 6 minutes).

Total time: 41 minutes, 35 seconds (partly estimated)

Session IV

Recall relaxation by counting in semi-prone position. Count itself takes 1 minute, 36 seconds. Various muscle groups mentioned during pause between numbers (6 minutes).

While in relaxed state: "monitor your success in letting go;" "enjoy your breathing;" "let your mind gear up or down to your body;" "visualize your mind as a muscle, allowing it to relax" (8 minutes).

Move into seated upright position with entire spine straight. Become aware of the column of support in spine. No longer are you letting the pillows support all your weight. Close your eyes (2 minutes, 20 seconds).

Relaxation sequence (tension/relaxation) in upright seated position.
1. both arms
2. area along length of spine (tense by coming into a
rigid upright posture; relax by letting go without losing the upright position of body.

3. muscles of the neck (first with total collapse of the head for the relaxation, repeat and relax without letting the head collapse over. Did I just once, 2 twice. 3 done in the two modes described with particular emphasis on the challenge of redefining the meaning of "relaxation" in reference to the maintenance of posture. Rotate head gently and try to maintain the same level of relaxation in the neck as you do this (12 minutes).

Short break (2 minutes, 10 seconds).

Move to seated position in chairs with pillows for support. Instructor discusses the problem of maintaining upright posture while still relaxing; the difficulty is in finding the proper balance between the two (3 minutes).

Relaxation sequence using four muscle groups in seated position. Use tension/relaxation alternation in following areas:

1. both arms
2. length of spine; try to release all tension in this area without collapsing the spine.
3. upper chest and shoulders; hold breath during tension, remain upright as you fully relax the area. Upright, but not tense!
4. neck, using two modes; first with complete collapse (falling over) of the head upon relaxation, then relaxation of the neck muscles while keeping the head poised on the spinal support. Feel the difference and notice how little effort is needed for the head to remain upright and comfortable (9 minutes, 40 seconds).

"Yawn-sigh" exercise in seated position. Maintain awareness of the relaxed state of the muscles as you balance this against your comfortable upright seated posture. Notice how the yawn-sigh affects this state. If you feel tension, release it. After two repetitions, Subjects are asked to do one "50% louder than the first" and to sense if the additional effort affects their ability to relax. After repeating this, Subjects are asked to start on a higher pitch than before and to notice changes (3 minutes, 40 seconds).

Discussion. One subject reports soreness in her lower back which makes relaxation difficult today. Another reports that it is painful for her to sit up straight anyway and the activities tend to increase her discomfort. Instructor discusses the tendency of muscles to tense when we concentrate on them and the need to
distribute tension properly throughout the body. Discussion continues beyond end of of audio tape (7 minutes).

Total time: 53 minutes, 50 seconds

Session V

Brief review as subjects adopt seated position with back supported. What does it mean to relax when we have to support the body in an upright position (1 minute, 40 seconds)?

Recall relaxation in seated position. Relax four areas:
1. arms and shoulders together
2. upper spine (check this relaxation compared with that of the arms, note ease of breathing)
3. neck (first become aware of whole area, then release without collapsing)
4. facial muscles (let go of eyes cheeks, mouth area, chewing muscles

(6 minutes, 50 seconds)

In relaxed state, experiment with quiet, smooth jaw movements. On signal, drop jaw open comfortably. Leave it there and notice any changes in tension levels anywhere in the system. After enjoying this and noticing things for a while, repeat the opening but with increased jaw opening. How does the additional conscious opening influence relaxation in the neck, facial muscles and upper spine? Repeat this experiment (3 minutes, 40 seconds).

Open your eyes, become aware of the room. Alertly move the head from side to side. Notice how the additional movement as well as the enlarged field of awareness affects the relaxation level of the muscles. Is there more tendency for tension to creep in? Sense carefully and let go of tensions you sense (2 minutes, 20 seconds).

Sing three pitches (played d-c-d on piano) in easy, relaxed manner while noticing changes in relaxation. Keep eyes open. Is there extra effort involved? Does the act of singing the pitches disturb the equilibrium of the relaxed, balanced system? Allow the pitches to occur without any habitual grabs you may sense. Try again with pitch about 20% louder than at first. Notice any change brought on by the additional intensity (1 minute, 45 seconds).

Tension/relaxation sequence combined with singing. During the cue for singing ("one, ready, go"), a specific muscle group is to be tensed and the tension maintained during the singing of the pitches. On repeating the task, the same muscle group is to be consciously relaxed during the cue and this relaxation maintained during the singing of the exercise. The three muscle groups used are:
1. both arms
2. neck and facial muscles
3. upper chest and abdominal area

Subjects are asked to "put the voice on automatic," that is, to attend to the tension/relaxation state of the muscle group rather than to the quality of the tones being produced. Notice the difference between the intentionally tight tone and the consciously relaxed one. It is very important that you keep your attention on the relaxation right through the moment of vocal attack. Don't be distracted by the tone production. Raise pitches 1/2 step and repeat whole process (7 minutes, 50 seconds).

Short break. Subjects move around and discuss things they had noticed. One subject feels like she is "all neck" and can't get comfortable. Another has trouble finding the right equilibrium for her jaw. Comments indicate general rise in kinesthetic awareness (3 minutes, 50 seconds).

Recall relaxation using counting in seated position (2 minutes).

Sing three pitches (f-e flat-d flat) using "ready and go" cue. No tension/relaxation directives, just to get back in gear. Become aware of what you're doing, let go of unnecessary "static" or interference in the muscles (3 minutes, 45 seconds).

Tension/relaxation alternation sequence combined with singing (repeated). Slightly higher pitches used, same three muscles groups as above. Note contrast between the tensed preparation and the willfully relaxing one. Sense how you can attend to the jobs of getting the proper pitch and forming the vowel while at the same time consciously relaxing the muscle group (3 minutes, 45 seconds).

Sing first phrase of "All Through the Night." As you sing, keep sending messages to the body to let go. Trust that the voice will be o.k. and keep your mind focused on the relaxation process that starts in the preparation phase and continues through the singing. Sing phrase twice (3 minutes).

Discussion. Is there a conflict between relaxation and the ability to support the tone? How is an actual musical phrase different with respect to relaxation than a three note vocal exercise? When you notice tension coming, are you able to release it? Varied experiences are reported. Some subjects feel a self-consciousness which "ties them up" and makes them nervous. Most indicate that the activities make them aware of things they had not thought of before, and that they are somewhat able to consciously relax more while singing (8 minutes, 45 seconds).

Total time: 48 minutes, 25 seconds
Session VI

Recall relaxation in semi-prone position using counting (used to review after work in seated position). Eyes closed, body fully supported. Feel the relaxation, allow it to occur (3 minutes).

Sing three pitches with relaxation during cue; semi-prone position. Use f#-e-d and "one, ready, go" cue. Begin to relax during the cue. Divert your attention away from the demands of the singing to the sensations of relaxation. This exercise done four times, also using pitches a-g-f# (3 minutes, 35 seconds).

Sing the same pitches but 50% louder. Notice your ability to keep awareness on the relaxation. Allow the additional energy needed for the louder tone, but don’t try to sing louder by adding unnecessary tension to the muscles (30 seconds).

Move to seated position. Repeated singing exercise with relaxing preparation in this position. Pitches raised to b-a-g# with a little more volume. Notice how the additional effort may be influencing your ability to stay in control of the relaxation during the preparation. Try to relax and maintain this directive as you sing the tones (3 minutes, 30 seconds).

Sing the first phrase of "All Through the Night" (F major). Practice letting go of the tension during preparation to sing (no piano accompaniment). After two repetitions, subjects are asked to sing the phrase with "a more alive, energized tone but without losing your relaxation." Note changes, become aware of how your relaxation is affected. Sing second phrase in same manner (5 minutes).

Alternate tension/relaxation during preparation for the phrase. Do this with neck and facial muscles, then abdominals and back muscles. Subjects report that it is hard to let go of tension. Try ignoring the area that won’t respond and let go of some other area instead. The original tension may let go in response (3 minutes, 30 seconds).

Introduction to relaxation in standing position. Group does recall relaxation (no tension) using four muscle groups:
1. both arms
2. neck and face
3. upper back, shoulders, abdominal area
4. buttocks, upper legs

Run through relaxation sequence with these groups. Keep your eyes open now for balance. Notice relaxation ability and how the relaxation is balanced with the requirements for maintaining upright posture. Notice how the breathing pattern interacts with your relaxation in the muscle groups. Allow the body to maintain its
posture without using any unnecessary effort (8 minutes, 20 seconds).

Sing "All Through the Night" in standing position. Same guidelines as before. Notice how the combination of standing and singing influences your ability to stay in touch with the conscious command to relax. Raise key to G major with louder volume. Notice changes in relaxation, allow tension to let go without collapsing body or losing energy in the tone (3 minutes, 10 seconds).

Sing three consecutive phrases of "All Through the Night." Do the higher pitches of the third phrase tend to distract you from your relaxation awareness? Perform last phrase to end song. Subjects sit down for discussion. Subsequent sessions will focus on improving ability to sing with less and less unnecessary muscle tension (3 minutes).

Repeat the song with piano accompaniment (F major). Keep noticing relaxation levels and letting go of unnecessary tension. Repeat song in G major after using brief recall relaxation sequence (1-5 count) to recover fully relaxed state. Subjects sit down for discussion and summary. There is a tendency for tension to appear at the ends of phrases (when breath supply is low). This is noted and discussed (9 minutes).

Total time: 42 minutes, 35 seconds

Session VII

Opening discussion: the challenge of maintaining upright posture while relaxing unnecessary muscle tension (3 minutes).

What are the elements of a good singing posture? Responses: spine straight, head even, rib cage high, spine "stretched." Subjects adopt this position while seated. General agreement that this "correct position" is not very comfortable. Conclusion: such postural directives are often misunderstood. The proper singing posture must be a coordinated, flexible balance rather than a static position. Experimented with "high rib cage" directive. Having adopted this position, can you now relax the muscles that are overly tense without collapsing the chest (2 minutes, 20 seconds).

Recall relaxation in abdominal/lower back muscles while seated in normal "good singing posture." It is noted that subjects seemed able to do this relaxation on cue without much visible sagging of the spine or rib cage (2 minutes, 40 seconds).

Recall relaxation in neck and shoulder muscles after adopting a high rib cage position. Can the rib cage height be maintained without pulling and lifting with the shoulder muscles? Noted less
visible sag of the rib cage, general relaxation of the shoulders in most subjects (2 minutes, 10 seconds).

Sing three pitch exercise (d-e-d) under two conditions: "normal" (no conscious tensing or relaxing) followed by repetition with conscious relaxation. In previous exercises, subjects had consciously tensed the muscle group and then compared this sensation with that of the conscious relaxation. Now, as in recall relaxation, the tension is eliminated and the relaxation is kinesthetically contrasted to the "normal" performance of the task. This procedure is done with the abdominal/lower back area and the neck/shoulder area (4 minutes, 40 seconds).

Subjects standing. What additional elements of "good posture" come into play in the standing position? Try to discover a straight spinal support which produces a feeling of energy and a pleasant emotional state (1 minute, 10 seconds).

Recall relaxation in standing position, no singing. Abdominal/lower back and neck/shoulder groups used. Consciously release all tension in the muscle group on cue without collapsing the posture. Notice what occurs and try to discover the balance between the posture and the relaxing of unnecessary tension. Experiment with exaggerated spinal "stretch" and high rib cage positions. See if you can relax without collapsing. Concentrate on two muscle groups simultaneously. One subject notes that she seems to have to send contrasting messages to her body; an "up" message to maintain posture and a "down" message to relax (4 minutes, 10 seconds).

Sing refrain from "Greensleeves," first in "normal" manner (no intentional tensing or relaxation). Repeat the singing with conscious relaxation of back muscles during preparation for the attack. Second repetition after reminders to maintain balance between good posture and constant active relaxation. Do entire sequence again featuring the neck and shoulder area (8 minutes, 45 seconds).

Subjects sit down. Instructor defines the term "inhibition" as the process of noticing something and then deciding not to do it—a conscious decision not to act. Discussion of awareness (3 minutes).

Relaxation when singing a high, climactic phrase, subjects standing. Use last climactic phrase from "What I Did for Love." Piano introduction is to play previous phrase ("wish me luck, the same to you."). Repeat this several times, stressing conscious relaxation during the introduction, not being distracted from the relaxation by fear of the high tones, and maintaining the decision to relax throughout the singing of the phrase. Alternate between low and high keys in standing and seated positions. Discussion (9 minutes).
Same singing but with specific relaxation in neck/shoulder area. "Let them become mushy, but don't collapse." Repeat this activity. Discussion follows (5 minutes).

Total time: 45 minutes, 55 seconds

Session VIII

Instructor reviews the concept of inhibition. Inhibition is based on awareness. Awareness leads to greater ability to choose the quality of our activities. The larger the number of things we must attend to, the harder it is to concentrate on relaxation. Demonstration activity:

1. consciously relax the right shoulder
2. do #1 while adding together the numbers 43 and 39.
3. do #1 while adding together the numbers 57 and 45 and listening to the sounds outside the window.

The activity demonstrates that the relaxation thought can easily be blocked out be competing thoughts. There is no easy solution, but becoming aware of this tendency is the key to making improvement (7 minutes).

Some subjects feel that they relax better by actively moving the muscle than by simply thinking about it. The pure thinking sometimes seems to create more tension in the area. Are these approaches opposed to each other? No. Perhaps one could try to use the stretching movements to increase kinesthetic awareness of how the relaxed muscle feels with the goal of returning to the relaxed state next time with less dependence on the overt movement (3 minutes).

Recall relaxation through entire body. Name specific parts of the body and let subject relax in seated position. Numerous reminders to notice ease of breathing and interrelationship between the various parts of the relaxed body (7 minutes, 45 seconds).

Sing "All Through the Night" (F major), first in normal manner, then with conscious relaxation during the piano introduction. Subjects can choose either to relax a particular part of the body, or to issue a global relaxation message to the entire body. Repeat in C major. Various feedback, including one subject's feeling that she was "too relaxed," unable to focus energy in the tone. Discussion of the paradox between full relaxation and the energy needed for singing. How do we know what to relax and what to energize? Repeat song with noticeably better group sound on tape. Agreement that the relaxation technique is probably not as useful when one feels tired and de-energized (7 minutes, 45 seconds).

Sing last refrain of "Climb Every Mountain" (forte volume, high pitches). Piano introduction is previous phrase from every day of
your life, for as long as you live..." First time normally, second time with conscious relaxation message to the body during the piano introduction. Evaluate your ability to maintain the thought of relaxation and release during the preparation and beginning of the phrase. Discussion. One subject notes that the energy required to sing drives out her ability to concentrate on relaxation. The class is reminded that this relaxation training is only a tool for gaining insight into what is going on in the physical coordination. We are concerned with making improvement, not reaching perfection (8 minutes, 30 seconds).

Repeat "Climb Every Mountain," this time singing from the phrase, "every day of your life..." Try to maintain awareness and relaxation throughout the body while you sing the section leading up to the high, forte phrase. What are you doing to release tension during the inhalation between "live" and "Climb?" Repeated the activity (5 minutes).

Total time: 38 minutes, 30 seconds

Session 7X

Discussion of subjects' experience in that day's voice class final exam. How did you deal with performance anxiety and the tension which accompanies it? Did the relaxation training help? Subjects agreed that the training had been of some help but that they still had a hard time relaxing during the actual graded performance. Merely telling yourself to calm down will rarely help you reduce performance tension. You must identify something specific which you can consciously release and relax (7 minutes, 45 seconds).

Review of inhibition. Inhibition should not be viewed as a negative thing, a clamping down. Rather, it is simply the interposing of a moment of choice between the intention to act and the action itself. Demonstration activity:

1. quickly touch your opposite ear with your index finger by reaching behind your head.
2. repeat the action while analyzing the movement.
3. repeat again, but choose to do it a little differently than before.

The activity demonstrates how we can modify an habitual action once we have consciously become aware of what we are doing. Even small improvements in our ability to observe ourselves can lead to greater efficiency in our movements (3 minutes, 45 seconds).

Relaxation isn't the same thing as "letting down." Demonstration activity: tighten back muscles and notice the
shortening and pulling down which occurs. When we relax from this tension, the body moves up. Real relaxation really allows the body to lengthen up and out as it was designed to do (1 minute).

Recall relaxation sequence in chair using counting. Collapse over onto writing desk during the count (2 minutes, 50 seconds).

Move slowly, smoothly to upright seated position. Relax and release as you rise. Find balance for the spine and head. Try some easy rotations of the head, neck and shoulders. Get in touch with the deep relaxation sensation (1 minute, 40 seconds).

Stand up. Feel ease of deep breaths, find balance between full relaxation and good posture. Do vocal warmups as in voice class:
1. yawn-sighs
2. 5-tone scale on "ja"
3. 1-3-5-3-1 arpeggio on "ja"
(7 minutes, 30 seconds)

KG sings "Till There was You" for the class. She is advised to remain aware of the audience as she concentrates on the area of her body which has been most responsive to relaxation messages. Starting during the piano introduction, allow the relaxation to occur and maintain this active relaxation throughout the performance. KG sings the song twice (13 minutes, 30 seconds).

BL sings "On a Clear Day" for the class, concentrating on releasing neck tension. Repeats the song with better success. BL notes that, though the relaxation process helped, he found that if he waited too long to send the relaxation message to his body, the tension would "take over" and he would not be able to relax at all (9 minutes, 20 seconds).

AN sings "Every Night When the Sun Goes In" for the class. She tends to feel tension "all over," but tries to focus her relaxation thoughts on releasing jaw tension to get mouth open. She notes that she felt tension in her arms but thought that allowing this tension helped keep tension out of her throat (8 minutes, 40 seconds).

Total time: 56 minutes

Session X

The class practices combining stretching activities with increased awareness. Do various movements of the shoulder which give you a feeling of relaxation. When you are done, spend about 30 seconds tuning in to the relaxation and notice if you can retain the relaxed feeling after the movement has ceased. Repeat with neck and then the jaw. This activity is to be a reminder that stretching is likely to be most effective when combined with active kinesthetic awareness (5 minutes, 20 seconds).
Warmup exercises:
1. 5-tone descending scale on open "ja" (consciously relax during the modulation to next repetition.)
2. rapid repeated 5-tone pattern, alternate "ja" on upward scale and "jo" on descending (keep thought on releasing during the breathing interval)
3. unison singing of "Amazing Grace"
4. unison singing of portion of "Put on a Happy Face" (from "and spread sunshine")

During the singing of the two songs, subjects are encouraged to release tension during the preparation for each phrase (11 minutes, 25 seconds).

DE sings "Let Us Break Bread Together" for class. She focuses on relaxing abdominal pressure in order to get rid of her "belting" coordination. A faint, but clear head voice began to emerge in place of the cutting out of the voice which had been occurring (8 minutes, 35 seconds).

PF sings "Today" for the class. Relaxation efforts seem to help her enter upper voice without as much grab. She releases shoulder tension on second verse and notices that the tone feels easier (5 minutes, 50 seconds).

AL sings "Tonight" for the class. On repeat she tries to concentrate relaxation efforts on the rib cage and keep it "responsive to the inhalation" in order to get more air (7 minutes, 35 seconds).

ST sings "It Only Takes a Moment" for the class. Instructor addresses her rather severe head thrust by having her focus on relaxing the back of the neck and visualizing her voice as a straight tube without any kinks or bends. Some improvement noted (8 minutes, 25 seconds).

Brief final review, dismissal (2 minutes).

Total time: 49 minutes, 10 seconds

Average daily treatment time: 46.6 minutes
APPENDIX E

ABSTRACT OF DAILY TREATMENT SESSIONS,

VOCALIZATION GROUP
ABSTRACT OF DAILY TREATMENT SESSIONS, VOCALIZATION GROUP

Session I

Introduction to the sessions. The goal of the class is to engage in daily practice of standard vocal exercises and discover how physical tension can be reduced through emphasizing relaxation and increased awareness. At the beginning of each session there will be a time for careful stretching and relaxation. About halfway through the vocalization session, after a short break, the relaxation activities will be repeated. More vocalization and unison singing will finish out the session. The goal is to find out if returning to the relaxation activities increases the effectiveness of the vocalization training. Instructor hands out sheet with exercises (see end of this appendix) (5 minutes).

Stretching and relaxation activity. Back massage, spine rollovers, rotations, etc. Move through all major joints with reminders to keep breathing, feel relaxation and release throughout the whole body (5 minutes).

Vocalization sequence using the following exercises from sheets:

#15 on [ha] in middle of vocal range. Repeat on [ho]. Take slower, easier breaths, don't rush yourself.
#16 on [ha] with imagery for loose, released abdominal pulse rather than tight, localized one. Keep the [h] free and airy.
#1 on [no], rearticulating the [n] at each phrase mark. Get all the breath you need but avoid getting tense when you breathe. Tension often comes in when you are running out of air.
(14 minutes, 20 seconds)

Short break (3 minutes, 40 seconds).

Repeat relaxation activities. Same sequence as at start (5 minutes).

Vocalization sequence using the following exercises:

#4 using [no] with breath before the eighth notes. Emphasis on releasing and strengthening the middle of the range rather than forcing into the high range. Repeat on [na], faster with more excitement and feeling of energy.
Discussion: where do you feel tension the most? When you feel unwanted tension, how do you go about releasing it? Methods included consciously moving the tensing area in the opposite direction and visualizing the body relaxing.

#22 using "Bob's mom went past." Listen for clean, crisp consonants and pure vowels. Also use "which one went west" (13 minutes, 40 seconds).

Summary. These are simple exercises and will be used to draw your attention to physical tensions so that you can learn to sing more freely (1 minute, 20 seconds).

Total time: 51 minutes

Session II

Relaxation and stretching activities (9 minutes, 50 seconds).

Vocalization using the following exercises:

#7 in key of D. Breathe after each fermata as necessary. Sing on a buzzy [m] to work for forward resonance. Feel vibration in face with yawny feeling behind. Do [mo], then [m-ma].

#2 using "Moe's show? No go!" Get buzz going through the [m] and allow the buzz to be in all the [o] vowels.

#17 on [pwi]. Bright sound, "launch it from a high thought." Work for relaxed openness combined with ping, yodel way up high in the head.

#39 on [ja]. Clearly conceptualize the top note in your mind before you start the pattern. (20 minutes, 10 seconds)

Short break (3 minutes).

Relaxation activities. Find released, balanced state with energy (3 minutes, 20 seconds).

Vocalization period using same exercises as above (15 minutes, 30 seconds).

Unison singing of "The Riddle Song" and "Simple Gifts." A "filler" activity since planned vocalization had ended a few minutes early (2 minutes, 40 seconds).

Total time: 54 minutes, 30 seconds
Session III

Relaxation and stretching activity (9 minutes, 10 seconds).

Vocalization period using the following exercises:

#14 on [hm]. Release the lips, face to get buzzy, loose [m]. Let [h] come freely through the nose. Sense abdominal pulse.
#8 on [ma me mi mo mu]. Keep [m] buzzy, free. Take full, comfortable breaths. Repeat with [na ne ni no nu].
#28 using [ni ni ni ni]. Don’t let [i] get tight. Try exaggerated nasal feeling. Repeat with [ni ni ne ne].
#13 using [si--a]
(22 minutes)

Short break (3 minutes).

Stretching, relaxation activities repeated (4 minutes, 30 seconds).

Repeat vocalization exercises as above. Emphasis today on finding a buzzy, forward resonance while maintaining balance and relaxation in the head, neck, jaw, tongue, etc. (11 minutes, 5 seconds).

Unison singing of "Almost Like Being in Love." Work on releasing, letting the tone be bright without any pinching (3 minutes, 25 seconds).

Total time: 53 minutes, 10 seconds

Session IV

Stretching, relaxation activity concluded by yawn-sighs (11 minutes, 30 seconds).

Vocalization using the following exercises:

#3 on [i e o e i e o e i--]. Also use same vowels with [n].
#20 with [no] repeat on each group of eighth notes.
#43 using "naaey" [njae] sound. Also use [di-do].
#51 on "feed these three geese, she pleads"
(19 minutes)

Short break (4 minutes, 40 seconds).

Relaxation activity. Become aware of the state of your body. Sense what needs to let go and come into balance (2 minutes, 40 seconds).
Repeat vocalization sequence as above except without use of #20. On #51 use "go slow, old foe, moan low" (8 minutes, 50 seconds).

Unison singing of "Almost Like Being in Love" (4 minutes).

Total time: 50 minutes, 40 seconds

Session V

Stretching relaxation activity. Somewhat longer today with careful attention to releasing entire body sequentially. Yawn-sigh vocalize to end this period (10 minutes).

Vocalization using the following exercises:

#25 starting in A major. Work for air-cushioned sound. Do first with loose throat and then with intentional tightness to feel contrast. Keep yawny, "up over the top" feeling.

#32 using "ye see me flee." Keep [i] bright but with relaxed tongue. Float the tone.

#35 on [ja je ja jo]. Use swell-diminish. Keep swelling right through the leap to the high tone. No scooping.

#42 Move notes quickly and lightly, keep body still, calm, relaxed.

(21 minutes, 30 seconds)

Short break (5 minutes).

Relaxation activity. Note that relaxation is not the same as collapsing (1 minute).

Vocalization using same exercises as above except without #42 (8 minutes, 30 seconds).

Unison singing of "Put On a Happy Face." Try to keep tension from accumulating near the end of the song (4 minutes, 25 seconds).

Total time: 50 minutes, 25 seconds

Session VI

Relaxation activity. Emphasis on ease of respiration, flexibility (10 minutes, 50 seconds).

Vocalization using the following exercises:

#11 with [ja] repeated every two eighth notes, then with single [ja] at beginning of the pattern.

#16 using [hm] for loose buzz and [h] through the nose, then [pwi].
#19 on [ni ne na no]
#41 with [no]
(17 minutes, 10 seconds)

Short break (2 minutes).

Relaxation activity (2 minutes, 30 seconds).

Vocalization using same exercises as above (13 minutes).

Unison singing of "Tonight" (4 minutes).

Total time: 49 minutes, 30 seconds

Session VII

Relaxation activities. Balance between need for energy in the body and the process of relaxation. Yawn-sighs to conclude (6 minutes, 50 seconds).

Vocalization using the following exercises:

#9a using [la be da me ni po tu]. Articulation should be crisp and light.
#31 with same syllables changing every quarter note or group of two eighths.
#22 using "Pat proved Mom's point." Do pattern first on "nasty" [njae] to get bright focus.
(20 minutes)

Short break (3 minutes).

Brief relaxation period (1 minute, 20 seconds).

Vocalization. Repeat #39a, skip #31, and do #22 using "wasps buzz when mad" (8 minutes).

Unison singing of "Tonight." Discuss ways to improve the freedom of the tone, then repeated performance (12 minutes, 45 seconds).

Total time: 51 minutes, 55 seconds

Session VIII

Relaxation activity. Yawn-sighs to conclude (8 minutes).

Vocalization using the following exercises:

#20 starting in G major. Yawny feel, use lots of air and "lift." Modulated up.
#15 with no pitch at first, just air release. No throat grab.
Added pitch, brightness gradually on [ha].
#6 on [jo], make sure tone in third measure is not pinched; go
"over the top" with lots of space.
#47 using [si mi ni] Keep the [i] bright and forward but loose
and free.

(21 minutes, 50 seconds)

Short break followed by very brief relaxation directives (2
minutes, 20 seconds).

Vocalization sequence using same exercises as above (11 minutes,
20 seconds).

Unison singing of "The Riddle Song" (5 minutes, 45 seconds).

Total time: 49 minutes, 15 seconds

Session IX

Relaxation, stretching activities. Conclude with staccato hisses
for abdominal pulse, air release (8 minutes, 35 seconds).

Vocalization using the following exercises:

#26 using [si--ja--] with swell-diminish.
#46 alternating [mi] and [mi] on the triplet groups. Replaced
[mi] with [t], [l].
#34 Use the crescendo to get into the high voice.
(13 minutes, 40 seconds)

Short break (1 minute, 20 seconds).

Unison singing of "Tonight" (3 minutes, 15 seconds).

Subjects had been told previously that the last part of sessions
IX and X would be spent hearing solo performances by class members.

DG: "Every Night When the Sun Goes In"
RK: "Dolce scherza"
AB: "Simple Gifts"
SM: "All Through the Night"

Performances followed by coaching suggestions, repeats of sections
or even the entire song (24 minutes, 15 seconds).

Total time: 51 minutes, 05 seconds
Session X

Relaxation activities (4 minutes).

Vocalization using the following exercises:

#24 on [si]. Work for lift, height, lots of space.
#33 starting on [si---ja], then using [a---ha!] and [o---no!]
(8 minutes, 30 seconds)

Unison singing of "Morning Has Broken" (3 minutes, 50 seconds).

Solos:

NH: "Every Night When the Sun Goes In"
SB: "Come Again"
TS: "Every Night When the Sun Goes In"
AG: "Come Again"

Performances followed by coaching and repetitions. Final session is
adjourned early to permit prompt start of audio posttesting
appointments (27 minutes, 40 seconds).

Total time: 44 minutes

Average daily treatment time: 50.55 seconds
VOCALISES

1. 

2. 

3. 
Oh Ay Ee Ah oh Ay Ee Ah, oh
Oh Ay Ah Ee oh Ay Ah Ee

4. 
No...
Nah...

5. 

6. 

7. 
m—oh—m—oh—m—oh—m—oh
m—Ah—m—Ah—m—Ah—m—Ah

8. 

9. 
La-be-da-me-ni-po-tu La-be-da...
La...

10. 

Ah
Oh
Appendix E/186

22. Bobs Which Pat
    one proved buzz
    went moms when past.

23. Oh

24. (Repeat on each vowel)

25. (Repeat on various vowels)

26. 

27. 

28. 

29. Meh moh moh moh moh moh

30. uh oh uh

31. }
APPENDIX F

AUDIO EVALUATOR'S INSTRUCTIONS AND

SCORING SHEETS
EVALUATION INSTRUCTIONS

You are being asked to use a Likert-type scale (1-9) to evaluate singing tone quality in a number of recorded examples. This is obviously a difficult task; tone quality is a very subjective term. The following list may help you understand how tone quality should be understood for the purposes of this study.

Factors to be considered (not in order of importance)

- tonal warmth versus stridency or harshness
- pitch accuracy, steadiness
- proper focus, placement
- overall clarity of diction
- perception of tightness/freedom in larynx, jaw, etc.
- natural-sounding (appropriate to age, development)

Factors not to be considered

- "bobbled" words (i.e. missing first word "My")
- foreign accents
- rhythmic variations, errors
- breathing sounds, other noise during piano interludes
- isolated errors that are not characteristic of the performance as a whole.

Note that the subjects were asked to sing this song "with patriotic fervor." Some displayed more zeal than others. This should not affect your evaluation.

All of the subjects (with one exception) were between the ages of 18 and 23 and were enrolled in a non-major voice class at The Ohio State University. None of them had had previous voice training.

You will hear some voices more than once. Try to be as consistent as you can. Naturally the factors above will vary in prominence from example to example, but maintain as much objectivity as possible. If you want to comment on any of the examples, jot a note just beneath the evaluation scale.
SCORE SHEET

Judge #__________

Rate each excerpt for tone quality, with 1 denoting "poor" and 9 indicating "excellent. Keep in mind the criteria discussed in the instructions.

Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
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Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
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Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
Ex. ___ 1 2 3 4 5 6 7 8 9  Ex. ___ 1 2 3 4 5 6 7 8 9
APPENDIX G

TRANSCRIPT OF TAPED DIRECTIONS

FOR EMG TEST
TRANSCRIPT OF TAPED DIRECTIONS FOR ENG TEST

This experiment has three parts. In each of the first two parts you will sing six different pitches. The pitches will be from the high and upper medium parts of your vocal range. They will be played on an electric piano which sounds like this [Tape was paused and examples played on a Yamaha DX7 keyboard]. You will sing back each pitch at one of two volume levels; either "loud," which will mean a fully-energized, well-projected tone, or you will be asked to sing "very loud," which means as loudly as possible without distorting the pitch. In either case, use your best, well-supported production, and use the vowel sound "ah" as in father. You must also sustain each pitch for as long as you can hold it without becoming uncomfortable. All pitches will be played for you at the same volume level. If at any time you feel uncomfortable or want to ask a question, please indicate this and we will pause. Otherwise, please stand quietly with good posture, moving as little as possible.

Here are some more sample pitches. Sing them back to get used to the sound you hear from the electric piano [Paused tape and played various pitches for subject to sing back until it was certain that the subject could answer back in the proper octave].

Now we are ready to begin. This is Part I. In this section you will first hear the number of the trial, such as "Part I, Number 1." This will be followed by the word "loud" or "very loud" to let you know what loudness level to use on the tone which follows. You will then hear two clicking sounds followed by a pitch. After the pitch stops, take your breath and then sing the pitch on the vowel "ah" at the requested volume level. Don't rush. Hold the pitch as long as you can. There will be six pitches in Part I, but first we will practice the procedure. Here is Part I, Practice Trial Number 1, loud. [Trials used pre-recorded one-second metronome pulses; click for two pulses, one pulse silence, pitch played on electric piano for two pulses. Paused for questions, clarification]. Here is Part I, Practice Trial Number 2, very loud [Did second practice, repeated practices as necessary].

We are now ready to do the six pitches in Part I [Ran tape with six trials, pitches played according to the following pattern:

1. Perfect 5th below #6--Loud
2. Major 2nd below #6--Very Loud
3. Perfect 4th below #6--Very Loud
4. Minor 2nd below #6--Loud
5. Minor 6th below #6--Loud
6. Top of reachable range--Very Loud

Note that #6, the last pitch, was the reference for all the others. In the case of male subjects, the top of the range was established as the pitch at which the subject broke into falsetto voice when ascending a scale *forte*.

In Part II of this experiment you will again sing six different pitches, but this time you will hear a rhythmic pulse which will specify for you exactly when you are to begin singing the pitch. As before, you will hear the number of the trial followed by the word "loud" or "very loud." Then you will hear a total of eight clicks, occurring one every second. Think of the clicks in terms of four groups of two. The clicking sound will first be heard by itself for two counts. During the next two counts the pitch will be played on the electric piano. The third group of two counts will give you time to get ready, and you are to begin singing the pitch during the fourth two counts, that is, on the seventh of the eight counts. Remember to hold the tone out as long as you comfortably can at the desired volume level on the vowel "ah."

Now let's practice this procedure. This is Part II, Practice Trial Number 1, loud [Played example, determined familiarity with procedure]. This is Part II, Practice Trial Number II, very loud [Paused for more practice, questions]. We will now do the six pitches of Part II [Used same pitches and volumes as in Part I. Rhythmic track as follows:

\[
\begin{align*}
\text{x - x - x - x - x - x - x - x} \\
\text{pitch) (sing--------} \\
\text{[----------- EMG recording---------------------]}
\end{align*}
\]

In the third part of this experiment you will again sing the short patriotic song which you sang during the tape recording session. At this time the tape will be changed and you will be using the same tape you used in the previous session [Tape was changed, subject sang song as in audio recording session].
LIST OF REFERENCES


